Agricultural Experiment Station

of the

UNIVERSITY OF KENTUCKY

FIFTIETH ANNUAL REPORT

For the Year 1937

IMPERIAL MYCOLOGICAL
20 JUNE 1938
INSTITUTE

Part I

Report of the Director

UNIVERSITY OF KENTUCKY

LEXINGTON, KENTUCKY

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LETTER OF TRANSMITTAL

To His Excellency, Hon. A. B. Chandler, Governor of Kentucky:

Sir: In accordance with an act of Congress, approved March 2, 1887, entitled, "An Act to establish Agricultural Experiment Stations, in connection with the Agricultural Colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and of the act of the Legislature of the State of Kentucky, approved February 20, 1888, entitled, "An Act to accept the provisions of an act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with Agricultural Colleges established by the several states and territories under an act of Congress approved July 2, 1862, "I herewith submit the Fiftieth Annual Report of the Kentucky Agricultural Experiment Station.

Very respectfully,

THOMAS P. COOPER, *Director*

January 1, 1938.

ANNUAL REPORT

of the

DIRECTOR OF THE KENTUCKY AGRICULTURAL EXPERIMENT STATION

For the Year 1937

The addition to the Experiment Station building, which had been under construction for approximately a year, was completed and the accommodations thus afforded partially relieved the congestion in offices and laboratories. With the provision of better facilities for the conduct of its work, the Experiment Station made substantial progress during 1937. However, with the increasing demands made upon the Station there continues to be need for additional quarters.

Early in the year, thru contributions from private individuals and organizations, it was possible to undertake organized research for the cause and prevention of periodic ophthalmia in horses. A survey disclosed wide prevalence of this disease.

A study was made of more than 500 horses and a detailed examination made of the eye. Approximately 10 percent of the number showed lesions indicative of periodic ophthalmia. The major portion of the work during the year was to determine if the cause of the disease is a filterable virus. An attempt was made to grow the virus on chick embryos and to transmit the disease to horses, rabbits and other animals thru intra-ocular injections, as well as by other means of transmission. In addition, 12 or 15 horses were used for direct intra-ocular injection. The results were not positive, altho it was observed that animals inoculated with material from the eyes of horses, both fresh and filtered, showed a greater degree of reaction than does the eye when injected with sterile, inert liquids.

The initiation of this study necessitated additional space. A temporary laboratory was constructed and a stable repaired and rearranged. This will meet the needs temporarily, but

within the next two or three years, a laboratory building must be provided if the work in animal pathology is to be properly conducted and expanded. Large values are involved in the livestock industry and the control of animal diseases is most important to Kentucky farmers.

Noteworthy progress was made in research in tobacco. Preliminary studies were undertaken in methods of curing burley tobacco, but they have not proceeded far enough to permit reporting the results. With the equipment provided for the tobacco research laboratory, it will be possible to duplicate in terms of humidity, temperature and air velocity, the conditions under which tobacco is cured by growers. It is anticipated that much new and worth while information will be obtained from these investigations. Burley tobacco No. 16, the seed of which was first distributed in 1935, has met with most favorable reception and is now being produced on possibly one-fourth of the burley tobacco acreage in the state. It is a strain developed by the Experiment Station and is highly resistant to root rot and produces uniformly higher yield per acre due to the greater number of leaves per plant.

At the Western Kentucky Substation, the study of diseases of dark tobacco was continued. The results are proving helpful and are being put into practice by the growers in the dark tobacco area.

The production of strawberries is a large enterprise in Kentucky, especially in the western part of the state. Frequently, an income of a million dollars or more is realized from the sale of this crop. A few years ago, it was found that the standard methods for the prevention and control of the crown borer were ineffective. An investigation was made at the Western Kentucky Substation, from which it was learned that the migration of the insects occurs much earlier in the year than had been supposed. A modified method of control was formulated which promises to be effective. This study should be completed after another season's investigation in the field.

Cooperative investigations, many of them of an emergency type, were carried on with various governmental agencies. Often the investigations were concerned with problems in a

limited area or with questions which would give information upon various programs which were in progress. While these investigations have required the time of the staff they are valuable in enabling the Experiment Station to broaden its service to the citizens of the state.

An enormous volume of work was carried by the public service laboratories and included this year 177,609 examinations. The work was so heavy that it absorbed the funds available for the laboratories to such an extent that it was not possible to purchase new equipment and needed supplies. These laboratories are performing an important and necessary service for the state and it is desirable that sufficient funds should be made available for their maintenance, supplies and essential equipment.

The dairy barn was erected 36 years ago. Not only is it obsolete, but it is also a fire hazard and it is expensive to keep in repair. There is urgent need for the erection of a barn as near fire proof as possible and equipped with the facilities to meet the needs of research in dairy husbandry and the requirements now demanded of dairy farmers.

The University campus is being extended to the area near the present horse barn, so that it will be necessary to construct a barn at a location more suitable for carrying on the work of the farm.

Servicing buildings from the central heating plant is a decided advantage. It has eliminated the expense incident to separate heating units and thru the removal of heating equipment from the building, more working space was provided.

The varied activities of the Experiment Station are presented briefly in this report. Results of work and detailed reports of the research projects are set forth in 10 bulletins, 3 circulars, 44 scientific papers, and in other miscellaneous publications which were issued during the year.

Control of angular leafspot and wildfire of tobacco. In western Kentucky, tobacco fields set from beds given two treatments of bluestone-lime mixture were damaged but little from angular leafspot and wildfire. The following table shows the loss from bacterial leafspots (wildfire and angular leafspot) in

field-grown tobacco set from Bordeaux-treated and untreated beds.

	Number of fields with percent of loss										
	Bordeaux treated					Not treated					
Percent of loss	0	T*	1	2	17	0	T*	1-4	5-10	11-20	21-50
Dark fire-cured	27	4	2	3	1	4	3	2	12	6	7
One sucker	10	0	2	0	0	5	5	4	16	12	12
Burley	9	1	2	0	0	2	12	0	7	1	1
All fields	46	5	6	3	1	11	20	6	35	19	20

*T=trace.

Blue mold of tobacco. For the first time in the history of tobacco growing in Kentucky, blue mold (*Peronospora tabacina*) caused extensive injury to tobacco beds in Kentucky. It was seen first in Todd County on May 13 and soon appeared in beds to the east and west, and gradually spread over most of the State. It appeared in destructive form in the first beds at about setting time, thereby delaying setting about a week or ten days. In the northern half of the State it usually appeared too late to cause much injury. Acreage finally set was probably not at all affected by the disease. It was observed in Todd County that beds which had received two applications of bluestone-lime mixture long before the first appearance of the disease usually sustained little injury while untreated beds in the immediate vicinity were severely injured.

Tobacco mosaic control under farm conditions. Tobacco mosaic has been controlled on the experimental fields in Kentucky for over ten years by requiring the men who handle plants to refrain from the use of barn-cured tobacco, to brush out their pockets and wash their hands before handling plants in the plant bed and while setting. Growers are beginning to realize the value of these measures, especially in the dark-fired area where mosaic burn is very injurious to the most valuable upper leaves when the virus is spread while worming and topping. In 1936 and 1937 surveys were made just before cutting time which showed clearly the origin of mosaic and

the means of preventing it. The results obtained in 1937 may be summarized as follows:

	No. fields	Percent mosaic
Workmen chewed or smoked barn-cured tobacco	85	20.9
Workmen used no barn-cured tobacco until after setting	44	1.6
Workmen used no tobacco thruout the season	33	.55

A new tobacco plant-bed disease. In both White Burley tobacco and dark tobacco a disease was observed which appeared to be quite destructive. Very small plants to plants about 4 inches in diameter, gradually turned yellow and when handled were likely to snap off at the surface of the ground. The crown of the plant was partially dry rotted. The decayed or discolored area penetrated the stem, leaf petioles and root for a short distance. A dark-colored fungus, possibly a species of alternaria, was consistently isolated from these plants. The disease was probably associated with the unusually wet plant-bed season.

Black leg of tobacco. This disease caused by *Bacillus aroideae* was unusually prevalent in plant beds and in certain fields appeared to result in poor stands of plants. It is possible, however, that some of these poor stands may have been caused by a combination of flea beetle larvae injury and soft rot organisms.

Brown root-rot of tobacco. A disease quite similar in symptoms to brown root-rot as described in other states was unusually prevalent in Kentucky this year in all types of tobacco. Much of the crop did not start into rapid growth until about the first of August, after which it recovered remarkably. Quite striking differences were noted in resistance of different varieties of White Burley tobacco to this disease. There was more than two weeks difference in blooming period of varieties which normally bloom at about the same time. Tobacco grown on land on which a heavy bluegrass sod was turned under, showed little or none of the disease.

Black-root-rot resistant tobacco. White Burley No. 16, a new variety developed at this Station some years ago, by hybridization, was tried extensively by farmers over the state. It

seems to be more resistant to black root rot than our resistant No. 5, is of as good quality and yields about 200 pounds more per acre. Certified seed will be on the market in 1938. Good progress is being made in breeding strains of dark tobacco resistant to black root rot.

Mosaic resistant tobacco. Back crossing on F_2 hybrids of Ambalema and White Burley yielded a strain in which the desirable characters of White Burley appear to be combined with resistance to mosaic. Twenty-four strains of mosaic-resistant Burley set in the field and inoculated with white mosaic showed no signs of spread of the virus in the majority of plants. Further back crossing will be necessary before a mosaic-resistant variety will be ready for trial by farmers. Similar breeding work with dark tobacco is under way.

Low-nicotine tobacco. A cross of White Burley with Baur's low-nicotine tobacco has produced fairly good types of Burley which yielded, by analysis, from 0.05 to 0.2 percent of nicotine. Further back crossing will be necessary before a variety of satisfactory type can be produced.

Yield of tobacco seed. White Burley tobacco plants average about 23 grams of cleaned seed each, or at the rate of 220 lbs. per acre. The increase in seed yield resulting from allowing seed to ripen completely will pay many times over the loss of leaf which would otherwise be saved if the seed crop was harvested green.

Thallium toxicity and frenching of tobacco. Turkish and Burley tobacco plants were grown in sand and water cultures with thallium additions to compare the effect of thallium toxicity and frenching. Varying degrees of chlorosis were produced but in none of the plants did this resemble frenching in all particulars. There were differences when the entire plants were considered and differences between the manner of appearance and disappearance of the two types of chlorosis from which it would appear that the two are not identical.

Tobacco yields on experiment fields. The yields and prices of tobacco for 1937 are not available for the annual report; consequently the yields for 1936 are presented. The rotation used for tobacco on these fields is tobacco two years, with a cover crop between, wheat, followed by three years of blue-

grass, with which red clover and Korean lespedeza are seeded. At Campbellsville and Mayfield the land is uniformly manured at the rate of 6 tons per acre. No manure was used at Greenville for the tobacco reported. Yields and values from certain selected treatments are given below, for 1936. Burley tobacco was grown at Campbellsville, and dark fired tobacco at the other places.

	Pounds per acre				Value per acre—dollars			
	O	LP	LPKN	PKN	O	LP	LPKN	PKN
Campbellsville	895	952	1302	1326	271	293	524	568
Greenville	744	1064	1157	1133	77	134	146	133
Mayfield	1355	1540	1891	1632	138	154	196	147

Cooperative Marketing of Tobacco. Beginning in 1785, tobacco produced in Kentucky was prized into hogsheads on the farm and shipped by boat to New Orleans for sale. Markets were established in Kentucky as early as 1825, however New Orleans continued to be the most important market for Kentucky tobacco until about 1860. Selling methods gradually changed until about 1900 when farmers sold their tobacco loose in the barn to dealers who prized and shipped it to central markets. Early in the twentieth century, large buying interests began making purchases directly from farmers rather than from local dealers. Circumstances attending this change, along with a decline in tobacco prices, stimulated a movement among farmers for organized selling which continued from 1903 until 1914.

Organizations of this period were largely overhead selling agencies for collective bargaining in which marketing functions such as financing and the physical handling of products were performed by private agencies. The cooperative organization supervised sales and bargained for rates to be charged in financing, insuring, storing, and handling the crop. Laws governing cooperative associations and membership contracts were not well developed. Consequently, a simple one-year contract with no penalty provision was employed. Tobacco was not commingled and title remained with the grower rather than passing to the organization. Settlement was made

between the buyer and the grower with the association supervising the transaction. The outbreak of the World War and the widespread adoption of looseleaf auction selling brought this period of cooperative tobacco marketing to a close.

Price differentials between grades of tobacco. A preliminary analysis suggests that differentials paid for quality in Burley tobacco are fairly constant from year to year, as measured in percent of a base price. Using the price of third-quality leaf as the base, second-quality sold 25-30 percent higher, and first quality 40 percent higher. Somewhat less pronounced differences were paid for differences in quality of lugs and flyings.

Geographical variations in the farm price of tobacco. Analysis of prices received by nearly 21,000 growers of Burley tobacco indicates that average prices by communities ranged from less than 10 cents to more than 22 cents a pound, in 1934. In general, the highest priced tobacco was from communities in the inner bluegrass region. Tobacco from communities in the outer bluegrass region, the mountains and the western part of the state, averaged somewhat lower in price. Soil appears to be an important factor influencing the price received for tobacco. Tabulation of the incomplete information available for 1934 and 1935 shows an average of $20.68 per 100 lbs., from 22 communities in the inner bluegrass region, $17.46 per 100 lbs. from 18 communities in the outer bluegrass region, and $17.02 from 18 communities in the Eden shale area. Prices on some markets are definitely and fairly uniformly higher than on other markets, probably because of differences in the average quality of tobacco sold, rather than differences in market facilities.

Factors which influence the price of Burley tobacco. Prices of commodities often are registered as changes up or down from previously prevailing prices. An analysis of factors which seem to cause changes from year to year in the price of Burley tobacco, indicates that, if allowance is made for the general level of all commodity prices, the size of the crop which comes to market is the most important single factor which affects the price of Burley tobacco. Quality seems of next importance and the amount of tobacco in storage is a third important factor affecting price.

Annual use of Burley tobacco. During the past 25 years the manufacture of cigarettes has increased, on the average, about 5¾ billion cigarettes per year while the amount of manufactured tobacco has decreased about 5 million pounds per year. The net effect of these changes has been an average increase in the use of Burley tobacco of about 3⅓ million pounds per year. On the average, the use of Burley tobacco has increased about 1¼ million pounds with each increase of one billion cigarettes while for each million pounds of manufactured tobacco, Burley was used to the extent of about ¾ of a million pounds.

Monthly reports on the amount of tobacco products manufactured are available from the Bureau of Internal Revenue. Multiple correlation analysis indicates that the amount of Burley tobacco used may be estimated with a fair degree of accuracy from the data included in these reports which cover the number of cigarettes and the amount of other tobacco products manufactured, including smoking, chewing, plug, and twist. These are considered to be the most important uses of Burley tobacco.

Organization of the Louisville fruit and vegetable market. The study of the Louisville fruit and vegetable market was continued thruout the season. One of the problems studied this season was the grading and packaging of fruits and vegetables. The commodities studied were kale, spinach, cabbage, beans, peas, tomatoes, strawberries, and grapes. Type of container and weight of contents of packages were two of the factors used in classifying the packages. The weight of strawberries contained in a crate was found to vary from 24 to 37 pounds, with an average of about 31 pounds. Quality or size of berry seemed to make very little difference in respect to the weight of a crate of berries, while the way berries were placed in cups and the fullness of cups seemed to be principal factors in determining the weight. Berries packed in new or fancy display crates found a more ready sale than the berries packed in second hand crates, even tho the berries were of about equal quality.

The type of container, new, old or indifferent, did not make such difference in the sale of spinach, nor did the weight of

the contents altho baskets of spinach varied in weight from 11 to 29 pounds and averaged about 18 pounds. The quality and condition of spinach were important factors in making the sales. Spinach is easily bruised and if too much is put into a package some of it may be crushed and thus may become undesirable. The dampness of the spinach influences to a considerable extent the weight of the package.

Data were secured on the market disposal of 275 loads of locally-grown produce. Many producers arrived at the market late in the afternoon in order to take advantage of the evening market as well as the early morning market, while others arrived at the market just prior to the morning sale period. Those who arrived in the afternoon during May sold their loads and returned home in about the same length of time as those who sold on the morning market only. This rapid afternoon sale was almost entirely due to the quick sale of strawberries to truckers. During June, however, the producers who arrived at market in the afternoon spent nearly twice as much time on the market as did those who arrived in the early morning. As the season progressed the difference in time on the market increased until during August producers who arrived in the afternoon spent nearly three times as long on the market disposing of about the same amount of produce as did those who arrived after midnight.

Data on 275 loads during May, June, July, and August showed that it took an average of 9.5 hours on the market to dispose of an average load, with an average of an hour for coming to market and an hour for returning home, so that producers were away from home an average of 11.5 hours on the days they went to market. The average value of a load was $44.86 and the out-of-pocket cost was $1.57 per load, in addition to the yearly cost of the stall.

The 217 itinerant trucker merchants who brought produce into Louisville during July and August hauled 1,081 truck loads into the market, while 53 other itinerant truckers who hauled produce away from the city hauled 199 loads away. Of the 270 thus moving produce into or out of the market only 5, or 1.85 percent, hauled produce both into and away from the market.

Receipts of produce shipped by motor trucks showed that 738 truck loads of watermelons, or a total of 340,000 melons were brought to Louisville and sold on the Gardeners and Farmers Market. The shipments were from Indiana, Georgia, Alabama, Missouri, Florida, Illinois, and Tennessee. There were 168 loads of peaches consisting of 22,315 bushels originating in Michigan, Kentucky, Illinois, Indiana and Georgia, and 651 loads of apples from Indiana, Michigan, Illinois, Kentucky, Tennessee, Missouri and Ohio. These composed the receipts on the Gardeners and Farmers Market and do not take into consideration the many truck loads delivered directly to commission merchants. These figures indicate that the movement of fruits and vegetables by motor truck continued to increase during the year.

The first part of this study was published in Kentucky Agricultural Experiment Station Bulletin 368, Organization of the Louisville Fruit and Vegetable Market.

The Lexington milk market. The study of organization and methods of marketing milk in Lexington was completed. It was found that about a third of the milk used in Lexington and nearly half of the milk sold in bottles is handled by producer-distributors who produce and sell raw milk. The remaining two-thirds of the supply is divided between plant distributors who purchase all their milk from farmers and producer-pasteurizers who produce milk, operate pasteurizing plants and purchase supplementary supplies from other dairymen.

Under the present marketing system farmers bargain individually for the sale of their milk and those who sell to pasteurizing plants usually receive a flat price per hundredweight. In the past, this price conformed to Chicago butter prices except in times of extreme shortage or surplus when dealers paid whatever was necessary to get supplies. The price of milk alone does not seem to determine milk production. In the Lexington milkshed there has been a high turnover in dairymen and it appears that the relative profitableness of other farm enterprises as well as feed and pasture conditions have a profound effect on the supply of milk.

The consumption of milk is much less variable than the

supply. This condition has tended to create surpluses and shortages. During 1932 and 1933, the market as a whole was short of milk at times, but since then supplies have increased. The most serious problem now is the wide seasonal variation in milk production. This problem is intensified by the presence of a large number of distributors, by maldistribution of supplies among distributors, and by noncooperation between marketing agencies.

The 1932-1936 per capita average consumption of milk, cream and buttermilk in Lexington was .56 pint per day as compared with .85 pint for the United States. Buttermilk constituted 21 percent of the daily per capita consumption.

The results of this study are published in Kentucky Agricultural Experiment Station Bulletin 377, Milk Marketing in Lexington.

Economics of hog production in Kentucky. The swine enterprise on Kentucky farms during the last 12 years yielded an average of 8.5 percent of the total cash income or 19 percent of the cash income from the livestock enterprise. Generally speaking, hog production is concentrated in the areas of heavy corn production but in the bluegrass region concentration is greater than that of corn, a condition which favors the production of feeder pigs in this area. Here many hogs are raised mainly on pasture and sold as feeders.

Distillery slop for hogs. In past experiments at this Station it was found that this feed in any form produced soft pork unless supplemented with a sufficient amount of corn and tankage. In this test the object was to determine if mineral material could replace part or all of the tankage and at the same time produce a carcass sufficiently firm to satisfy the packer; also to determine the smallest amount of tankage needed to supplement distillers' slop and corn to produce rapid gains. Settled distillery slop was used because in previous experiments it was found that this form was more efficient and economical than the thin form, as it is usually obtained from the distillery. The settled slop was obtained by bailing off and discarding the watery portion from the top of slop which had been allowed to settle 24 to 36 hours.

Five lots of 10 pigs each, averaging about 72 pounds per pig at the beginning of the test, were used, and the test lasted 98 days. The check lot received corn and tankage, self fed, supplemented with a mineral mixture of steamed bone meal, ground limestone and salt in proportion of 2-2-1, self fed. All the other lots received settled slop and corn in the proportion of 5 lbs. of slop to 1 lb. of corn, and had access to the 2-2-1 mineral mixture. Lot 2 got no tankage, lot 3 got 5 percent tankage in mineral mixture, lot 4 got 10 percent tankage, and lot 5 got tankage equal to 5 percent of the weight of corn. Five representative hogs were sent to packing plant from each lot. All the hogs in lot 1 which received no slop were hard or satisfactory to the packer; 3 out of 5 from lots 2 and 3 were medium soft; in lots 4 and 5, two were medium and one soft. Adding 5 or 10 percent, by weight, of tankage to the mineral supplement did not prevent the production of soft pork when the pigs were fed 5 lbs. of settled slop to 1 lb. of corn. The iodine number of the fat of lot 1, the check lot, was 65, while the number for the other lots was approximately 75.

Pasture for hogs. Sixteen pigs were placed on each of three pastures, alfalfa, oats and rape, and bluegrass, and were fed three percent of their weight in corn, daily. They were transferred to Korean lespedeza and a fresh alfalfa field, June 23, distributing them equally as to previous treatment. Lespedeza was not ready for pasture before June 23, and was eaten by the pigs until the seed passed out of the dough stage. At blossoming time the palatability of lespedeza was at its best; at other times it had rather a binding effect on hogs, and as it ripened and the stems dried the animals did not eat it. Oats and rape ranked next to alfalfa in rapidity and economy of gains, alfalfa ranking first. During the succulent stage of lespedeza the pigs sometimes did better on it than on alfalfa but the period when lespedeza is palatable is very short. Bluegrass ranked in value after alfalfa and oats and rape.

Function of manganese in prevention of slipped tendon in chicks. A manganese salt, injected into the growing chick, was effective in the prevention of slipped tendon, whereas salts of zinc, aluminum or iron showed no protective action. If the amount of manganese injected was not properly controlled, retarda-

tion in growth resulted and zinc at all levels caused some retardation. Manganese had a protective action against slipped tendon when fed to growing chicks while no protective action of zinc, aluminum and iron was noted. A minimum of 30 parts per million of manganese added to the basal ration containing 6 or 7 parts per million, was necessary for good growth and for the prevention of slipped tendon. A smaller quantity allowed the incidence of an appreciable percentage of slipped tendons. As much as 646 parts per million of manganese as manganese sulfate in the feed was not toxic.

Abnormality of the chick embryo produced by manganese deficiency in the diet of the hen. Eggs produced by hens fed a ration which produced slipped tendon in chicks, gave very low hatchability, with a peak of embryo mortality on the 20th and 21st days of incubation. The embryos that died after the tenth day of incubation were abnormal, characterized by very short, thickened legs, short wings, "parrot beak," globular contour of head, protruding abdomen, and retarded down and body growth in the most severe cases. Marked edema was noted in approximately 75 percent of these embryos. Hens fed the same ration supplemented with manganese, zinc and iron produced eggs which gave good hatchability of normal chicks, and dead embryos from this group showed normal skeletal development. The abnormal condition of the embryos was completely prevented by the injection of .03 mg. of manganese (as a dilute solution of the sulfate) directly into the albumen of eggs which if not injected produced embryos with this abnormality. The injection of zinc was ineffective. The hens fed the ration which produced abnormal embryos returned to the production of eggs that developed normal embryos, within 15 days after they were allowed green range, direct sunlight and a ration containing ample manganese.

The value of Korean lespedeza, lespedeza sericea and alfalfa leaf meals in chicken feed. Leaf meals of Korean lespedeza, lespedeza sericea and alfalfa were substituted for certain constituents of the all-mash ration of White Leghorn chicks kept in battery brooders. As measured by the gain in weight of the chicks, the results show that either of these meals or a mixture of them is a satisfactory substitute for wheat feed, on the basis

of equal amounts of protein, but they do not serve as substitutes for meat scrap or milk.

The influence of corn on the production and composition of chicken fat. Four lots of young chicks on a basal ration were fed different amounts of ground yellow corn to determine the effect of corn on the quantity and character of fat deposited by the chicks. The quantity of body fat deposited was greatest in the lot receiving the largest quantity of corn and decreased as the quantity of corn in the feed decreased. The refractive index of the gland oil of the chicks was appreciably lower than that of the body fat. There was no characteristic variation in the iodine number of the gland oil of the four lots, but it was smaller than that of the body fat. The iodine number of the body fat of the chicks that received most corn was smaller than that of the other lots. The diet affected the composition of the uropygial gland oil less than it affected that of the body fat.

The use of bluegrass in all-mash rations. Tho the proteins in air-dried bluegrass have high biological value, this material is not a satisfactory ingredient in all-mash rations for growing chicks because of the high fiber content (20.1 percent). Bluegrass should be fed *ad libitum* to chicks as a succulent feed.

High-protein concentrates in chick feeds. In an experiment with growing chicks to determine if it be necessary to add ground corn to a high-protein concentrate mixture, one lot was fed the concentrate and shelled corn in separate hoppers; the other was fed the concentrate mixed with an equal quantity of ground corn, in a separate hopper from shelled corn. Both methods proved satisfactory in producing good pullets. The pullets are being carried thru the first laying year to determine the effects of these growing rations on egg production.

Separate feeding of grain and meat scrap to pullets versus all-mash feeding. One lot received cracked yellow corn, whole wheat, and meat scrap, in separate hoppers; the other received a mash of 70 parts ground yellow corn, 25 parts of mixed wheat feed and 10 parts of meat scrap. Both lots were given skim-milk *ad libitum*. No appreciable difference was found in the egg production of the two lots.

Delayed conception in dairy heifers. About three hours before her first service each of five Jersey and four Holstein heifers was given a vaginal douche of one gallon of tepid water in which was dissolved 40 grams each of sodium chloride and sodium bicarbonate. Six other heifers (3 Jerseys and 3 Holsteins) received an injection of 5 cc commercial extract of corpus luteum five days before the predicted date of heat when they were to be given their first service, another similar injection the day they were bred and two others, one and two weeks later. Five other heifers (3 Jerseys and 2 Holsteins), used as controls, received no treatment before or after service. The bulls were vigorous, of known potency, and all except one were young and in their first year of active service. Each of the heifers which received the douche treatment conceived at first service. Three of those that received the corpus luteum extract conceived at first service, one at second service, and sufficient time has not passed to show whether or not the other two are yet safe in calf following the first service. Of the controls, two conceived at first service, one at second, one at tenth, one has been served twice and sufficient time has not yet elapsed to make sure as to conception.

Reproductive efficiency in dairy cows. The reproductive efficiency has been computed by calendar years for the females that were in the Kentucky Agricultural Experiment Station dairy herd from 1900 to 1936, inclusive. One hundred percent reproductive efficiency means that each female of breeding age produces one calf for each twelve months that she is in the herd. Nine months of pregnancy are counted as equivalent to one calf. The difference between the months of pregnancy for the herd January 1, and December 31, is divided by nine. These are called potential calves and are added to or subtracted from the number of calves born. The weighted average of the reproductive efficiency for the thirty-seven years (1900 to 1936, inclusive) is 71.0 percent. This means that each female of breeding age produced one calf for each 16.9 months that she was in the herd.

Eradication of Bang's disease was begun in September, 1928. The herd became Bang's disease free January 1, 1933. The weighted average of the reproductive efficiency for the thirty-

three years (1900 to 1932, inclusive) that Bang's disease was in the herd is 69.0 percent. This is an interval of 17.4 months between calves. The weighted average of the reproductive efficiency for the four years (1933 to 1936, inclusive) that the herd was Bang's disease free is 84.5 percent. This is an interval of 14.2 months between calves. A herd of 100 cows with an interval between calves of 17.4 months would produce 69 calves per year, while 100 cows with an interval between calves of 14.2 months would produce 84.5 calves per year, a difference of 15.5 calves per year.

Low productive efficiency means more services per pregnancy, a longer interval between calves, and low milk production for the herd even tho individual animals may be high milk producers. The highest milk production in the Kentucky Agricultural Experiment Station dairy herd before the eradication of Bang's disease was 8288.7 pounds per cow, in 1927. Milk production did not exceed 8000 pounds in any other of the thirty-three years. Average milk production since Bang's disease was eradicated was 8585.5 pounds per cow per year.

Aseptically drawn milk. A bacteriological study of milk aseptically drawn indicates that a high percentage of Bang's disease reactors gave milk with an agglutinin titer for *Brucella abortus* of 1:50 or higher. Many of these cows may discharge *Brucella abortus* in their milk. The higher percentage of Bang's-disease-positive cows that gave positive reactions to other tests indicative of mastitis indicates that resistance of these cows to other udder infections may be lowered because of the Bang's disease. The management of a herd containing both Bang's disease positive and negative cows is an important factor in the control of mastitis. Each of these diseases in itself is responsible for a severe economic loss to the dairyman; when both occur together it may mean the difference between success or failure of the dairy enterprise because of the large loss these diseases cause.

Paratyphoid bacilli. The study of *Salmonella typhi-murium* (*S. aertrycke*) cultures from pigeons was continued. More than fifty strains from widely separated areas have been examined. The definite conclusion is that cultures of *S. typhi-murium* of the type which is enzootic in pigeons in the United States

can be differentiated serologically from cultures of *S. typhi-murium* occurring in other animals. The strains from pigeons lack factor $\overline{V}$ of the Kauffman-White schema. This variant has been found in no other animal species except rabbits which were kept in contact with infected pigeons. The recognition of certain cultures of human origin as members of the variant type indicates that the infection is transmissible to man.

The possibility of differentiating cultures of *S. typhi-murium* from different outbreaks of human and animal was studied further. The rapidity of the fermentation of xylose apparently is a reliable criterion for the separation of strains of this species into two types. All the cultures from any given outbreak of the infection are invariably identical in their action on xylose. However, cultures from some outbreaks attack the sugar rapidly, while cultures from another outbreak may attack it slowly. This difference in behavior should be valuable in the study of the epizoology and epidemiology of *S. typhi-murium* infection.

S. newport, which had previously been recognized in diseases of feeder cattle, has also been found in diseases of chickens and swine. Two new Salmonella species, both isolated from diseased chicks, were identified. The first, which was isolated at the New Jersey Agricultural Experiment Station, was designated *S. new brunswick.* This organism, in addition to being a hitherto undescribed type, contained a previously unrecognized group antigen. Its antigenic formula is $\overline{III}$ $\overline{VX}$: lv : 1,7. The second new species was isolated at this Station and was designated *S. kentucky.* It contained two undescribed antigens. The antigenic formula of *S. kentucky* is $\overline{VIII}$ $\overline{XX}$: i-z6: -. The organism exhibits alpha-beta phase variation.

Corynebacterium equi. Attempts were made to develop positive methods of differentiation of cultures of *Corynebact. equi.* isolated from cases of pneumonia of foals, from certain closely related cultures derived from the genital tract of mares and from fetuses. This work is important since it involves the question of prenatal infection with this organism. Serological work demonstrated that the cultures are divisible into two agglutinative types: one composed entirely of cultures from foals; the other in which cultures from mares and fetuses are

predominant. Biochemical studies of the organisms indicate that while they produce neither acid nor gas from carbohydrates, sugar is probably utilized in their growth. This is indicated by the stimulating effect of glucose when the organisms are grown on a synthetic medium.

Trichomoniasis in dairy cattle. In Kentucky, the protozoan, *Trichomonas fetus,* of Reidmuller, was first definitely diagnosed in the reproductive system of dairy cattle, April 3, 1937. Since then it has been found in the uterus or vagina of seven cows, in two aborted fetuses, and in the preputial secretions of one bull. All these animals were in the same herd. Trichomonads were apparently introduced into the herd by the bull, since the trouble began with the first females that were bred to him. The herd consisted of two breeds and the infection was confined to one breed. Symptoms observed in the cows were abortion, inflammation of vagina and cervix, pyometra, irregular estrual cycle and discharge from the reproductive system. The discharge is usually a thin, grayish fluid containing small clumps but it may be thin and clear or thick and contain pus. The bull showed inflammation of the prepuce and penis and diminished sexual desire. One of the aborted fetuses was carried 142 days, the other 154 days. Treatments used were apparently not of much value. It probably is best to withhold affected animals from breeding until the reproductive system returns to normal and the cow has passed thru at least two normal estrual cycles.

Paralysis in colts (wobblers). A characteristic symptom of the disease is lack of coordination, most pronounced in the hind legs, occasionally evident in the fore legs. It is a disease of young animals, most often observed in sucklings, weanlings and yearlings, rarely in older animals. Death from the disease is very unusual; however, animals affected seldom, if ever, completely recover and their usefulness is destroyed. Autopsies of 7 animals showed pathological lesions in some part of the osseous system. In three cases there was one or more definite constrictions in the cervical spinal canal. Some of the cervical vertebrae were enlarged and malformed to the extent of producing a constriction of the intervertebral foramen and spinal canal. Periarthritis and degenerative atrophy

of the articular cartilage of the vertebrae in more than one region were present in all cases. Gross lesions of abnormal bone development were present in five out of the six cases examined. Histopathological examinations are being carried out on both bone and nerve tissue. Specimens so far examined reveal changes in the osseous structures that are indicative of defective and abnormal bone development. The cord and nerves show changes that suggest pressure atrophy. The finding of rather pronounced lesions in the bones suggests the possibility that the primary disturbance is in the bones and joints rather than in the nervous system.

Submarginal land studies. A study was made of all the land drained by one of the large tributaries of the Cumberland River, in Knox County, typical of many other areas in Eastern Kentucky. The farms in the area averaged 63½ acres. More than 1/3 of the farms had no well-lying land and only about half had as much as 5 acres of such land. The number of persons per family averaged 5½. The cash income averaged $68. per family for the year.

A few crops of corn exhaust the humus supply of freshly cleared hillside land thus permitting erosion which, if not controlled, renders the land unfit for growing either corn or timber. A study of a cropping cycle of 24 years on 28 hillside fields indicates that on the average only 8 crops of corn may be expected on such land. When it is cleared first, 5 crops are grown. It is then left to grow in weeds and brush for a number of years. When cleared a second time, it may produce 3 crops of corn, averaging not over 10 bushels to the acre.

The land area may be divided into three classes. Class 1, uninhabited, almost wholly rough forest and waste land adapted only to growing trees. This class comprises 7 percent of the total acreage. Class 2 consists of land now largely in farms but unsuited for agricultural use. This class is about 76 percent of the total acreage. Class 3 consists of fairly good agricultural land and is about 17 percent of the acreage. Only land in class 3 should be used for permanent agriculture. The study seems to warrant the following conclusions: Land in class 1 should be reserved for permanent forest; almost all the land in class 2 should eventually be abandoned as farm land

and reserved for forest use. The owners and operators of farms in class 3 should find means of making the maximum use of their land resources; that is, they should farm as intensively as is practical.

A land-use analysis was made of two blocks of land in Knox County located along the Cumberland River and in the valley of Big Richland Creek, a tributary of Cumberland River. The study indicates that more than three-fourths of the 165 farms in the Big Richland Creek bottoms have insufficient land for successful full-time farming; that there is at present a surplus farm population on this creek; and that any program of relocation of families from more rugged sections would further aggravate the situation. The block of land in the Cumberland River area furnishes land resources sufficient for the people living on this land at present but offers no opportunity for the resettlement of families from other land except to the extent that incoming families replace present occupants. The immediate need is to find means of making the maximum use of existing land resources. This would call for the use of the more intensive kinds of crops and intensifying the culture of all crops on the limited areas of good agricultural land. Families on the rougher, poorer land should be encouraged and assisted to develop as completely as possible their limited land resources with the object in view of living where they are until opportunities for resettlement in industry or on suitable agricultural land become available. Eventually such farms should be evacuated, but the evacuation should be done slowly and voluntarily. A period of a generation or more may be required.

Projects for the purchase and reforestation of such lands have been put into effect in Kentucky and other states. In such projects it might be well in the case of older owners for the governmental agencies in buying the land to pay for it by the issuance of life annuity certificates, meanwhile permitting the occupants to use the dwelling houses and the land under prescribed conditions. Cultivation would be permitted only on the level land, or the gentler slopes. The occupants would have the use of the present house and such land for intertilled crops and such pasture land, and firewood as might thus be

permitted. At the death of the operators, entire possession would be taken by the governmental agency and the land would go back into forest.

Land tenure. In the decade, 1880 to 1890, the proportion of owners to tenants in Kentucky increased approximately one percent; during the period, 1890 to 1900, the number of owner farms decreased 8 percent while the number of tenants increased 72 percent and the number of farms, 31 percent. During this period the acreage devoted to tobacco increased which, no doubt, was the cause of the increase in the number of tenants. In the 30-year period, 1900 to 1930, the number of tenants increased approximately 15 percent, the acreage of tobacco, 21 percent, and the number of farms, 5 percent. In 1935, approximately 37 percent of all farms in Kentucky were operated by tenants.

A study made in 1937, of 410 farms in central and southern Kentucky, disclosed the following facts. In Logan County the labor income of operating tenants was $346; share croppers, $268; landlord-operators, $281; owner-operators, $287, and regularly employed hired hands, $250. The average net worth of owners was $7,600; of operating tenants, $1,100; of share-croppers $304, and of hired hands, $82. For the outer Bluegrass region the average income of operating tenants was $476; of share-croppers, $316; of owner-operators, $294; of landlord-operators, $108; and of regularly employed hired hands, $300.

Steps to farm ownership. Before they attained ownership of their farms, 115 typical farm owners in five central and southern Kentucky counties spent an average of 11 years as non-owners. Since beginning to work for themselves they have worked 34.4 years. Approximately one-third of their farm experience was as non-farm owners. Their average age was 55 years. Of the 115 farm owners 64 percent inherited all or part of their farms; only 35 percent earned their farms by their own efforts.

Tenancy changes in Central Kentucky since 1924. Reports as to the present tenure status of 116 Fayette County tenants, studied in 1925, were obtained in September, 1937. It was

found that 15 of the tenants have become farm owners, 2 have become owners of a house and lot and 2 have become farm managers. Seventy-five have remained tenants, 5 have become hired men, and 17 are now engaged in non-farm occupation. Stated in percentage of the total reporting, 13 percent have become farm owners, 2 percent have become owners of a house and lot, and 2 percent have become farm managers. Sixty-five percent have remained tenants, 4 percent have become hired hands, and 14 percent are now engaged in non-farm work.

Farm management studies. Studies of farms located in Anderson, Mercer, and Washington counties on which 85 percent of the soil was derived from limestone showed that 50 percent or more of the harvested crop land was devoted to alfalfa for hay and from one-half to two-thirds of the total farm acreage was in pasture. The sequence of crops most suitable to the "limestone" farms is a cultivated crop, corn or tobacco, followed by a winter cover crop seeded with a legume and grass, usually a mixture of alfalfa and orchard grass. The alfalfa and grass is cut for hay for four years or more after which bluegrass replaces it and the field is used for pasture for another period of four or more years. The farm receipts should come from livestock and animal products.

On 46 farms in northern Garrard County of the 180 studied in the Eden shale belt, the soil was largely of Garrard sandstone origin. On the "sandstone" farms 75 percent of the income should be derived from tobacco, 60 percent of the tillable land should be in pasture or hay and less than 25 percent in intertilled crops. A suggested rotation is a cultivated crop, tobacco preferred or corn, followed by a winter cover crop seeded to a mixture of legumes or grasses. The land is kept in grass for hay or pasture until needed for a cultivated crop again. Dairy cattle and poultry give approximately 25 percent of the farm income.

Sheep. Profits in sheep production were shown to be influenced principally by those flock management practices which affect, on the one hand, the cost items which are consistent with a large production of high-quality lambs and wool and, on the other, the income from them. A comparison of one-third

of the flocks having the highest net returns per ewe with an equal number of flocks having the lowest net returns per ewe shows that the income factors were responsible for 70 to 76 percent of the difference in net returns per ewe while the remaining 24 to 30 percent resulted from differences in items of cost. Differences in pounds of lamb produced per ewe, price received for lambs and pounds of wool produced per ewe accounted for the variations in income. Cost of harvested feed, depreciation of ewes and a few minor cost items made up the difference in cost per ewe. The farmers with the more profitable flocks had more prolific ewes, raised a larger percentage of the lambs born, and sold their lambs at heavier weights. In the more profitable flocks a larger percentage of the ewes were two to six years old than in the less profitable flocks. Ewes that had been drenched for three consecutive years produced more lambs than those not drenched.

Death loss of lambs was reduced by added care and better housing of the ewes and lambs during the lambing season and by keeping a thrifty ewe flock thru systematic culling of the old or inferior ewes, those with spoiled udders, and those that did not produce sufficient milk for rapid growth of the lamb.

Sheep make the greatest demands for labor during January, February, and March. This seasonal demand for man labor when the demand from other enterprises is the lightest makes it possible for the farmer who raises lambs and wool to derive an income from farm labor that would not otherwise be fully employed on income-producing enterprises. Likewise, the sheep enterprise provides an income from buildings and equipment which may not otherwise be fully used. Sheep also influence the farm earnings by helping to control weeds in seed and hay crops.

The study showed that in deciding whether or not the sheep enterprise will increase the farm earnings, it is necessary for the farm operator to determine how well the non-marketable feeds, the available man labor, horse work, and tobacco barns or other buildings that would provide shelter for sheep are being utilized. If it is found that additional pasture, non-marketable feeds, labor and shelter are available on the farm, the sheep will increase the earnings of the farm by the amount

that the receipts from the sheep exceed the value of marketable feeds, interest, depreciation and cash expense on sheep.

Hog production costs and returns. Production and production requirements, costs, returns and profitable management practices were obtained for 37 herds, 21 of which were in Union County and 16 in the Inner Bluegrass Area. The records for both areas indicate systems of feeding and management should be followed that will produce finished hogs in the shortest time and in accordance with market demands.

A group of the more successful hog raisers included in this study during 1936 used an average of 5.4 bushels of corn or its equivalent and 13 pounds of tankage for each hundred weight of gain. An equal number of less successful farmers used an average of 9.9 bushels of corn or its equivalent and only 4.5 pounds of tankage or its equivalent per hundred weight of gain. The more successful farmers raised a 200 pound hog in an average of 228 days while it required 312 days for the less successful group of farmers to raise a 200 pound hog.

The following of such practices in swine sanitation as providing lots, pasturage, and housing free of parasite infestation were closely associated with balanced rations and efficient feeding in producing rapid economical gains.

The most favorable periods for selling finished hogs, generally, are from about February 1 to March 15 and August 1 to September 15.

The records for Union County show the farmers producing finished hogs for market. The Inner Bluegrass records show both finished and feeder hogs being marketed. For 1935 and again in 1936 the feeder hogs were slightly more profitable.

Field work in soil management and crop production. Practically all the field work in soil management and crop production consists of projects that have been under way for several years and are designed to be continued indefinitely. Such experiments do not, as a rule, yield yearly results that have any great significance over those for any other single year. The results from the outlying soil experiment fields this year again

show in a very striking manner the cumulative value of good soil management. The yields are given below.

Field	Corn, Bus.			Wheat, Bus.			1st Year Hay, Lbs.		
	O	M	MLP	O	M	MLP	O	M	MLP
Berea*	4.7	12.9	28.5	Wheat not grown			1510	1350	3660
Fariston	3.6	13.6	55.0	0.5	6.6	25.6	000	000	3200
Campbellsville	9.9	40.3	62.6	1.3	8.8	25.0	270	710	3390
Greenville	16.7	28.7	52.5	5.3	21.5	37.3	1740	3570	5660
Mayfield	25.1	45.5	53.3	12.5	25.4	38.4	2650	1525	5040

O, no treatment; M, manure; L, limestone; P, superphosphate.
* Corn injured by dry weather.

Manure, where used, was applied at a rate equal to the weight of crops removed the previous year (wheat grain excepted). No limestone has been used on any of these fields since 1923, except at Berea. The total application at that time ranged from 4 to 6 tons per acre, except at Berea, where an additional application of 1 ton per acre was used between 1928 and 1930. For several years, lately, superphosphate (16 percent equivalent) has been used at the rate of 100 pounds per acre per year. Previously it was used at the rate of 200 pounds.

Residual effect of superphosphate and rock phosphate. Beginning in 1930 at Berea, and in 1931 at Greenville and Mayfield, certain plots previously treated with superphosphate and rock phosphate were divided, and the use of these materials was discontinued on one half of each plot and continued on the other half. At Berea there are three comparisons for each phosphate, at Greenville one for superphosphate and two for rock phosphate, and at Mayfield one for rock phosphate and two for superphosphate. The average crop yields for these plots for 1937 and for the period of the tests are given below:

	Superphosphate		Rock phosphate	
	Continued	Omitted	Continued	Omitted
Corn, bushels, 1937 yields	43.8	44.0	50.6	48.2
Corn, bushels, average 17 crops	49.0	47.9	51.8	51.6
Wheat, bushels, 1937 yields	37.8	36.4	38.4	37.1
Wheat, bushels, average 14 crops	23.7	20.9	23.2	23.2
First-year hay, lbs., 1937 yields	4662	3866	5368	5253
First-year hay, lbs., ave. 17 crops	3880	3487	4299	4236
Second-year hay, lbs. 1937 yields	3821	3570	3684	3715
Second-year hay, lbs., ave. 14 crops	4106	3969	4425	4368

For the first-year hay crop there were twenty-five cuttings on the three fields, and for the second-year hay, twenty-one cuttings.

Leaching of Nitrogen in Soil. Tests of the soil in which tobacco was growing on the Experiment Station farm showed that even when rainfall was heavy, no large amount of nitrate was carried below the plow layer and practically none below the surface foot during the summer. Leaching of nitrogen is not a problem in this soil during the summer. It has been found, however, that leaching removed practically all nitrate from the soil in most winters and that it is very important to follow such crops as tobacco with cover crops to prevent leaching losses.

Leaching of nitrogen is large in lysimeters after legumes which die in early fall. Certain legumes are grown alone, in association with bluegrass, or followed by a rye cover crop in lysimeters on the Experiment Station farm. During the 12 months' period ending March 31, 1937, leaching of nitrogen, on the acre basis, in certain lysimeters was as follows:

Where only Korean lespedeza grew	60 pounds
Where a rye cover crop followed the lespedeza	10 pounds
Where only red clover was grown the past three years and all the plants died in the fall of 1936	193 pounds
Where bluegrass grew with the clover	6 pounds

The results suggest that there is considerable leaching of nitrogen in the field after legumes which die by early fall, such as the lespedezas and red clover in the second year, unless a grass is seeded with them, or a small grain crop is seeded early in the fall after them.

Greenhouse tests of availability of phosphates. The phosphates listed below were tested in triplicate in soils from the Mayfield and Campbellsville soil fields and the Greenville, Princeton (limestone land) and Berea fields in cooperation with the Tennessee Valley Authority using wheat as the test crop. Finely ground limestone was used in all tests at the rate of 1,000 pounds per 2,000,000 pounds of soil. The phosphates were added at a rate to supply 100 pounds of P_2O_5 per 2,000,000 pounds of soil. Additions of nitrogen and potassium salts were made so that these nutrients would not limit crop growth.

Averaging all tests, the increase in crop yields from the various phosphates are as follows:

Phosphate	Increase in Crop yield Percent
Ordinary superphosphate	60
Triple superphosphate	52
Dicalcium phosphate	55
Tricalcium phosphate	46
Calcium metaphosphate	59
Fused rock phosphate	58
Raw rock phosphate (ordinary grinding)	4
Colloidal phosphate	3

Tests were also made of the availability of these phosphates to corn, alfalfa and white clover in certain of the soils. The results are similar to the above except that the relative increase for raw rock and colloidal phosphate was considerably greater.

Causes of success and failure of red clover. Studies of the relation of soil productivity to red clover failure during the year support the evidence of recent years that the environmental factor of low soil productivity, in itself, affects unadapted and adapted red clover similarly; that is, adapted varieties appear to be no better suited to growing on poor soil than are the unadapted kinds. The evidence for this conclusion is derived from two sets of data: first, the natural mortality rates of the two groups are essentially the same with reference to each other, irrespective of soil productivity, and, second, the differences in the starch storage and utilization by the two groups on poor soil are quite similar to the differences between the two groups on good soil. Some evidence has been obtained in the past, however, that when diseases or insects assume epiphytotic proportions on the clovers the unadapted kinds are injured more seriously, in comparison with adapted varieties, on poor soil than on good soil. In other words, the adapted varieties, under these conditions, on poor soil, appear to be more superior to unadapted kinds than they are on good soil.

Continuous and alternate grazing on permanent pasture. Satisfactory progress was made on this experiment during the year. During this grazing period of 196 days, identical num-

bers of dairy heifers per acre on the two areas of the Experiment Station farm made gains of 210 pounds per acre on the continuously grazed area, and 234 pounds per acre on the alternately grazed area. Observations indicated more uniform grazing and recovery on the alternate grazing plots. Two worth while results were obtained from the experiment: first, some measure of the productivity of pastures in the Central Bluegrass region, and, second, the possibility of their improvement thru management practices.

Improvement in red clover. The research in developing new strains of red clover is proceeding in a satisfactory way. One developed new strain will be tested in 1938 by field tests to determine its value. A new strain of orchard grass is being tested, and it gives promise of value.

Improvement of bluegrass. Strains of bluegrass for drouth resistance have been selected and are now in plot tests. They varied as much as 300 percent in yield of dry matter during the year and were strikingly different in herbage production thruout the growing season. Average yields of native Kentucky bluegrass and of bluegrass of the Missouri-Iowa region indicate that on the average there is little difference in adaptability of the two groups to Kentucky. It appears that distinct varieties of Kentucky bluegrass have developed on old bluegrass fields.

It was also found that Korean lespedeza has a very beneficial effect upon the growth of bluegrass. Also, evidence indicates that bluegrass-alfalfa mixtures require less care to maintain the association than many other legumes.

Alfalfa injury. During 1937 leaf hoppers (Empoasca fabae) severely injured all varieties under test. The total yields for the season of some of the certified varieties are as follows:

Hardigan	7265 pounds per acre
Kansas certified common	5500 pounds per acre
Grimm	4845 pounds per acre
Oklahoma "adapted"	4100 pounds per acre
Arizona common	2415 pounds per acre

The chemical analyses of Kentucky bluegrass, orchard grass, etc. Twelve comparable samples of common grasses have been analyzed and others are being prepared for analysis. Analyses are similar to those previously made, all of which indicate

one fact of greatest importance in human and livestock nutrition, namely, that crops grown on the highly phosphatic soils of the Bluegrass region contain two or more times as much phosphorus as crops from low prosphorus soil.

Results in breeding hybrid corn. Four of the hybrids representing combinations of inbreds produced by the Kentucky Experiment Station were tested this year in comparison with standard varieties and hybrids from other sources at 10 different points in the State. These tests were in addition to the more extensive tests including all Kentucky hybrids on the Experiment Station farm at Lexington and the Sub-Experiment Station farm at Princeton.

The soils on which the cooperative tests were located varied from rather low productivity to very productive, and seasonal conditions from very poor to excellent. In the test where the highest yields were obtained, the maximum yield was 103.8 bushels an acre, while in the test where yields were lowest, the highest yield was 48.0 bushels an acre. The plots, consisting of 1/60 acre each, were in triplicate. Yields given represent shelled corn containing 14.5 percent moisture.

The Kentucky hybrids included in the 8 tests were Nos. 69, 72, 76 and 80. The others were prominent hybrids from the central corn belt. The open-pollinated varieties used were Pride of Saline, the Experiment Station strain of Boone County White, a late maturing strain of Reid's, Midland Yellow Dent, Yellow Pride of Saline produced by the Kansas Experiment Station, and local varieties furnished by the cooperators. Not all the yellow hybrids or open-pollinated varieties were included in all the tests. Pride of Saline is widely distributed in Kentucky, and has proved to be an exceptionally dependable variety under varied soil and seasonal conditions. In the 8 tests the 4 Kentucky hybrids averaged 64.7 bus. an acre; Kentucky 76 averaged highest, 70.0 bus. an acre, and Kentucky 80, the lowest, 63.0 bushels an acre. Jewett's No. 6 yielded only 2.2 bushels less per acre than Kentucky 76, in the five tests in which it was included. Funk's 244 and 235 yielded approximately 4 bushels an acre less than Kentucky 76. No other yellow hybrid yielded as much as Kentucky 76 by 10 bushels an acre.

At Lexington 34 hybrids from various sources, chiefly early and medium early yellows, 16 Kentucky hybrids all white except one, and 10 open-pollinated varieties were compared. The open-pollinated varieties, particularly those maturing late, yielded much less than any but the latest maturing hybrids.

To obtain a wide distribution of hybrid seed, the Experiment Station furnished Utopia Clubs in 23 counties in the State with sufficient single cross seed to raise an acre of Kentucky hybrid No. 69. This project was planned by the Club Division of the Extension Department, members of which distributed the seed and directed the boys in growing the corn. Direct supervision was furnished by county agents. The boys were remarkably successful in this project, and most clubs produced from 30 to 50 bushels of hybrid seed much of which will be used in the counties where grown.

Rate of liming experiment. Again, clover showed the most injury from very heavy liming. Applications up to 10 tons of limestone per acre did not reduce the yield of any crop, but more than 4 tons per acre reduced the quality of Burley tobacco. Corn yields in 1937 on plots limed most heavily—namely, 10, 20, and 50 tons of limestone per acre, were about 10 percent less than on other plots. This corn yielded slightly less on all check plots than on plots receiving a moderate application of lime.

Results of Plot Treatments. Mayfield	1937 corn yield Bus. per acre
Limestone and superphosphate, no manure used	28.4
Limestone and superphosphate, no manure, (potash in hills)	52.1
Limestone and superphosphate—manured regularly	52.6

Wheat breeding and variety tests. The chief aims are to obtain varieties of greater cold resistance than the varieties now generally grown in Kentucky and more resistant to rusts, particularly leaf rust. There has been so little winter killing of wheat in Kentucky for the past several years that it has been impossible to determine cold resistance of various strains. Apparently efforts to obtain rust resistant varieties have not been successful. A number of strains were isolated again, from hybrid material, and it is hoped that some of these will

prove resistant and at the same time desirable in other respects.

The cooperative tests with the Bureau of Plant Industry were continued. These consist of winter-hardiness tests with numerous varieties of wheat and winter barley and tests of the rust resistance of various varieties of spring and winter wheats and spring oats.

Tobacco curing experiments. The objects of the experiments are:

1. To determine the effects of various temperatures, humidities and length of exposure during the yellowing period upon the quality of the cured leaf of Burley, fire-cured and dark air-cured types of tobacco. 2. To determine the effects of various air conditions during the drying period, upon the quality of the cured leaf of White Burley and dark air-cured tobacco. 3. To determine the role of temperature, humidity and smoke in producing the desired qualities in fire-cured tobacco.

To obtain this information curing chambers are required in which any desired degree of temperature and humidity can be maintained. Such chambers have been constructed and are in use in the tobacco research laboratory. To utilize fully the equipment, tobacco is grown in the greenhouse of the research laboratory as well as in the field. To date the use of the chambers indicates that the relatively high humidities generally believed desirable during the yellowing period are not necessary or desirable in the cure of White Burley.

Oats. A limited number of oat varieties are tested each year. Any promising varieties are tested. In the tests this year Kentucky No. 4, a black oat, yielded 59.4 bushels an acre, three bushels more than Columbia which ranked second. Kentucky No. 4 is the earliest maturing oat tested at the Station.

Drouth injury to corn on the Experiment Station farm. Deficiency of moisture rather than of nutrients has been found to limit yields of corn on the Experiment Station farm, as an average of a period of years. Uneven distribution of rainfall, of course, mainly accounts for this. The comparative closeness of rock to the surface of the soil (6-8 feet), also, may be a contributing factor of some importance. However,

it has been found that the crop suffers greatly for deficiency of moisture when considerable moisture is present in the soil below the surface two feet. Examination has shown that the roots of the crop are mainly in the plow layer and that very few are present below 18 inches. Apparently, also, capillary movement is not active enough to move much water up into the root zone during drouth periods.

The soil is Maury silt loam. It has a granular subsoil and drainage is good, but the clay content of the subsoil is high—50-70 percent and the subsoil appears not to favor capillary movement of moisture or root penetration of the crop.

Variety tests. In the apple orchard there was a heavy set of fruit this year but the drouth in late summer affected the size and quality of fruit and caused it to ripen prematurely. Some of the new varieties are noteworthy and Lodi shows much promise; the fruit resembles Transparent but is larger and of equally good quality.

Many trees of the peach orchard on the Experiment Station farm show injury in the heart wood from the severe cold of the winter of 1935-36 which injury resulted in a light crop in 1937. Search among available new varieties, for a large, yellow peach of the Elberta type that will ripen early, has discovered eight varieties that show much promise. These eight varieties are: Vedette, Valient, Viceroy, Veteran, Halehaven, Sun Glo, South Haven, and Golden Jubilee.

The strawberry crop was small, due to the severe drouth in 1936 which affected the stand of plants. The Catskill, a new variety, withstood the drouth and the yield was more than double that of any other variety in the test. Since this variety also showed up well at the Robinson Substation it would seem worthy of further trial.

Sixteen varieties of tomatoes were selected for testing. Comparisons were made on earliness, quality, size of fruit and yield. N. D. No. 215 produced the largest early yield and was third in fruit size. Some of the fruits were quite rough and the quality ranked as fair. Bonny Best and Valiant ranked next in earliness and had excellent size and quality. The Prairiana, previously reported for its productiveness, made the largest total yield in this test. Its rank in size and quality

was medium. Pritchard seemed to be one of the best varieties, ranking high in yield and size and quality of fruit. Stokesdale produced fruits of excellent size and quality but was average in yield.

The first season's growth of apple grafts as affected by type of stock and part of cion wood used. To test whole vs. piece root grafts and tip vs. basal cion wood, 766 grafts were made of 34 varieties. The percentage of mortality was considerably greater with piece than with branched whole root stocks. There was no significant difference in the growth of the different groups of grafts. Tip cion wood was as satisfactory as the basal part.

Use of manure mulch and nitrate of soda on Latham red raspberries. Because of failure to produce satisfactory growth of raspberry canes, combinations of manure mulch and nitrate of soda were used to encourage growth. Manure mulch gave a growth of more canes to the foot of row than nitrate of soda alone and equal to that produced by both together. It appears that the manure mulch encouraged the growth of the canes and had more influence on size than nitrate of soda.

The effect of fall nitrogen fertilization on the soluble nitrogen and phosphate phosphorus content of dormant peach twigs. Four sets of nine-year-old Elberta peach trees were fertilized on October 12 with sulfate of ammonia, 4 pounds per tree, nitrate of soda, 2 pounds and 4 pounds per tree, and calcium cyanamid, 2 pounds per tree. Two sets of three trees each were used as checks. Chemical determinations of soluble nitrogen and phosphate phosphorus in the twigs were made before the trees were fertilized and at weekly intervals for twenty-four weeks following the treatment. Statistical comparisons were made to show the comparative effect of the fertilizer treatments with the untreated trees. The general trend of soluble nitrogen was to diminish thru the winter, altho the fertilizer treatment in two cases considerably influenced this. When sulfate of ammonia was used the percentage of soluble nitrogen increased, as compared with the checks and fertilized trees before treatment. No other fertilizer treatment had this effect. Calcium cyanamid, on the other hand, had the effect of considerably lowering the percentage of soluble nitrogen and the reduction

was proportionately greater than in untreated trees. This fact may have some bearing on the susceptibility of trees to winter injury.

The percentage of phosphate phosphorus in twigs was more uniform thruout the period than that of soluble nitrogen. In general increase of nitrogen was associated with a reduction of phosphorus. The trees fertilized with sulfate of ammonia showed the smallest reduction in nitrogen during the winter but the greatest loss of phosphrus.

Relation between content of soluble nitrogen and phosphate phosphorus in the petioles of leaves and the yield of tomatoes. In tomatoes grown in the greenhouse in the spring of 1937 a significant relation was found between content of soluble nitrogen and yield. The relation between content of phosphate phosphorus and yield was not significant because any setback in plant growth was always accompanied by a rapid accumulation of phosphorus in the tissue. These results indicate an important point relative to the use of nitrogen fertilizers on tomatoes. In the early stages of growth the use of nitrogen fertilizers may stimulate excessive vegetative growth and depress yields but after the fruits begin to set the addition of nitrogen may increase the yield. Further work is needed to prove this point.

The relation of content of soluble nitrogen and phosphate phosphorus in the stems of snap beans to yield. Snap beans were grown in field plots treated to produce a gradient of N and P in the stems of the plants. The stems were analyzed at blossom time and correlations made with yield. The results show that the yield is positively correlated with the supply of nitrogen and that tests made on the stems at blossom time may be useful to determine if quickly available nitrogen fertilizers should be added to improve yield. The data on phosphorus show that this element was beneficial in the low range but not significantly so in the high range.

A rapid method for determining carbon in carbohydrate and protein compounds in plant tissue. Since the standard methods for determining total carbon in plant tissue require much time, and special equipment and technique, a simple method was desired which would permit rapid determination of a large number of

samples. By digesting the tissue with concentrated sulfuric acid to the point where carbonization is complete but oxidation is just beginning it was found that if the colloidal carbon formed was kept in a proper acid concentration, the depth of color could be used as an accurate measure of the carbon present. When the method was applied to pure carbohydrates, such as filter paper, cellophane and sugars, the results tallied closely with theory. Gluten analyzed by official methods yielded 54 to 55 percent carbon. Analyzed by the new method, 54.8 percent was found. This indicates that the method may be used to determine carbon in proteins. The method seems to be suitable for determinations on carbohydrates and proteins. Since practically all the carbon in vegetative plant tissue is present in carbohydrate or protein form the method seems to be adapted to carbon analysis of these tissues.

The effect of nitrogen fertilization on the yield of spring-crop potatoes. Potatoes were grown in field plots treated to produce a gradient of soluble nitrogen in the stems of the plants. When no fertilizer was used, soluble nitrogen in the stems ranged from less than 100 to about 200 ppm. The use of 100 pounds per acre of nitrate of soda resulted in a nitrogen content in the stems ranging from about 200 to about 500 ppm; 500 pounds per acre of nitrate of soda produced a content of about 500 to about 1000 ppm. The correlation between these findings and yield was significant. The greater the content of nitrogen in the stems the greater the yield, following the law of diminishing returns. It was apparent that the point at which increase in the amount of nitrogen in the tissues would not be associated with increased yield, was not reached in this test. The work indicates that plant analysis for nitrogen can be used to indicate the need for nitrogen fertilizer. Further work will be needed to determine the stage of growth at which the use of nitrogen fertilizer may be effective.

Application of the chlorate method for determining nitrogen to light, fluffy materials. Difficulty was experienced in determining total nitrogen in samples of plant tissue that were of a light, chaffy or fluffy nature when analyzed by the chlorate method. It was found that the difficulty was avoided by wetting the sample thoroly with the chlorate solution before add-

ing the sulfuric acid and heating. Then the phenoldisulfonic acid was added after the clear digestion mixture was cooled to room temperature. Samples run by this procedure checked with Kjeldahl determinations within 0.1 of a percent.

Corn earworm control. In previous reports it was pointed out that cutting off the silks of sweet corn, after pollination had taken place, is a promising method of control of the corn ear worm. In 1937 two procedures were found to give good results. The first may be called a rapid method. About 4 to 6 days after the silks began to turn brown and dry, the husks and silks at the tip of the ear were cut off with pruning shears to about one-fourth inch of the end of the cob. The clipped ends were taken from the field and destroyed. One man was able to clip more than one acre in a day. The number of infested ears was reduced by this method to less than 20 percent, while the checks contained about 90 percent of wormy ears. The second procedure was similar to the first except that after the clipping, the fresh cut surface was examined. A discolored spot would be found if a worm had gone beyond the cut. Usually, another cut revealed the worm but if not, the husk was turned back as far as required to remove the worm and then replaced. Cutting back of much of the cob was found to be undesirable. This procedure required more time than the first but reduced the damage to less than 10 percent when infestation was heavy.

The clipping should be done after most of the eggs have been laid on the silks and before the worms have entered the ear. After repeated trials it was found that the best time was 4 to 6 days after the first sign of browning of the silks, indicating that pollination has been completed. Ears clipped at this stage of growth healed and did not become unsightly, whereas clipping later resulted in discoloration and rotting at the cut. When clipped at the right time there was little damage by birds or by rotting.

Fluoride in mineral mixtures for livestock. Four samples of mineral mixtures were collected by the Department of Feeds and submitted to the Chemistry Department for the determination of fluorine. The fluorine content ranged from 0.37 to 0.55 percent of the mineral mixtures. The minimum amount of flourine found is considerably more than 10 times the toxic

limit of fluorine for domestic animals. An ample supply of mineral mixture was obtained for experiments with rats. Ten diets containing this particular mineral mixture have been fed to 58 experimental animals at various levels at periods of active growth. Growth and feeding records have indicated that when this mineral mixture is incorporated in a stock ration a retardation of normal growth and excessive feeding results. The effects were more pronounced during the middle of the period of most active growth. At no time did the addition of the mineral mixture increase the rate of animal growth. All of the animals on the diets containing the mineral mixture developed the characteristic mottling and tooth decay attributed to an excess of fluorine in the diet. A normal number of young were produced by the rats on the diet containing the mineral mixture but they were smaller than the normal stock rats and attained the weight-age for experimental purposes approximately two weeks later than the control animals.

Automatic watering system. An automatic device which maintains a definite degree of saturation in the soil of greenhouse cultures was contrived and operated successfully. Water is delivered thru a modified U-tube which acts as a siphon one end of which is in contact with the soil of the culture and the other immersed in water in a constant-level bottle. Adjustment of this tube determines the degree of wetness maintained in the soil. Determination of water in the soil in which plants were growing showed that a sensibly constant percentage was maintained. Besides the maintenance of a practically uniform water content in the soil, with very little attention, use of the device effects a great saving of labor in conducting pot experiments. The device has also been used successfully to water the soil of benches in the greenhouse. A description of the system was published in the Journal of the Americal Society of Agronomy, volume 29, page 797, 1937.

Function of boron in plant metabolism. Sweetpotato plants were grown in purified sand cultures. Those given near-toxic quantities of boron and then deprived of boron, developed characteristic symptoms. Excessive quantities of starch were stored in the leaf and stem cells of plants deficient in boron, and cracks and seams were often observed in the otherwise appar-

ently normal plant tissues. Plants grown in a low-boron culture contained less boron in the growing point than in the older leaves. This condition indicates that the boron is not translocated from the older to the newly formed tissues as is the case with some of the other elements which are essential in the metabolism of plants.

Hemoglobin regeneration value of egg yolk. Altho egg yolk has a high content of iron, it, nevertheless, has not given good results in regenerating hemoglobin. One of the reasons offered by investigators is that the high sulfur content of the egg yolk forms nonabsorbable or nonutilizable copper salts and that, therefore, the copper does not perform its normal function in helping the process of hemoglobin formation.

Since, in previous studies, it has been found that the copper and iron content of egg yolk varies with differences in treatment of the hens that lay the eggs, it was thought to be of value to test the hemoglobin-producing value of egg yolks having a comparatively high copper content. A selected group of eight anemic children were used as subjects. Two of them were given the diet they had been accustomed to having and no supplement was added. Four of them were given their accustomed diets plus the daily amount of egg yolk that furnished 0.05 mg. of copper per kilogram of body weight. Two were given the usual diet plus the daily addition of 0.1 mg. of iron in weak solution as ferrous chloride, and 0.05 mg. of copper as solution of the sulfate, per kilogram of body weight. Reticulocyte counts were made every day and the hemoglobin determined twice a week by the method of Newcomer.

Weight charts of the children were kept for weights taken at two week intervals. The weight change was so slight, it was felt that whatever was caused by the amount of egg yolk fed would not be significant at more frequent intervals of weighing. A record of food consumption was kept during the experiment and for six weeks prior to the test period.

After two and one-half months on this experiment, there had been no significant rise in either hemoglobin or recticulocytes. However, it was felt that the amount of iron or of copper, or of both, may not have been sufficient.

Control of sod webworm. A standard formula of kerosene

emulsion diluted at the rate of 1 part to 10 of water, applied to sod at the rate of 2 gallons to 20 square feet, gave an average kill of 96.5 percent, in five tests. Lead arsenate, 2 pounds in 20 gallons of water, with liquid tar soap as a sticker and spreader, gave an average kill of 86.8 percent, in five tests. Pyrethrum spray, 1 ounce in 4 gallons of water used at the rate of 2 gallons to 20 square feet, gave an average kill of 96.1 percent, in five tests. Other sprays tested gave a kill of 6 to 55 percent. The poisoned bait tested was not effective.

Resistance of clover to pea aphid infestation. Of the four clovers, in a controlled experiment, Kentucky 101, Tennessee, Louisiana and North Carolina, the Kentucky and Tennessee clovers showed a very much greater resistance than the other two kinds.

Control of insects injurious to tobacco plants in the bed. Two larvae that live in the soil frequently do a great deal of damage to plants in tobacco beds. These are the common white grubs and green June beetle grubs. The insecticides generally recommended for controlling these larvae are kerosene emulsion and arsenicals either worked into the soil or distributed on the surface of the soil. Carbon disulfide emulsion has also been recommended against these larvae, but earlier tests with this material showed too much injury to tobacco plants to recommend its use.

In the spring of 1937 three insecticides were used on a tobacco bed divided into three sections. 1. Kerosene emulsion made according to the standard formula was used as recommended for grubs, 1 gal. of 7.5 percent emulsion to each 6 sq. ft. The plants were small and were killed by the emulsion. 2. Lead arsenate 10 lbs. to 1000 sq. ft. was worked into the soil before sowing the seed. Germination on the plot was poor, only about 1-3 of expected plants. On another plot lead arsenate applied as a spray to very small plants did not injure them but was not effective in killing the grubs. 3. The third section was treated with BB[1] dichloroethyl ether, 10 cc in one gallon of water applied at the rate of one gallon of the mixture per square yard. The treatment did not injure the plants. This spray had no effect when applied on June beetle larvae in trays in the insectary.

Control of wireworm injury to tobacco in the field. The season was generally favorable to getting a good stand of plants at transplanting time. Several practices were carried out for observing their effect on the amount of wireworm injury to tobacco. Fall plowing did not reduce or lessen injury as was the case for three previous seasons. As a matter of record, more plants were injured in fall-plowed land than in spring-plowed land, 34.3 percent as compared with 23.2 percent for spring-plowed land. Plants set on slight ridges showed 12.5 percent injured plants and in furrows 22.5 percent, a considerable difference in favor of planting on ridges. Plants of different size were compared in four plots. The plants used ranged from 4 to 8 mm in diameter of stem. There was practically no difference in the percentages of plants injured, but the number of plants that died from injury was slightly less for the larger plants. The percentage of plants that died from injury ranged from 2.06 of the smallest to 0.74 of the largest. In a comparison of different varieties no real difference in resistance was observed. Plants set on different dates showed considerable difference in the amount of injury, the plants set latest being injured least. Tobacco planted the second time on the same plot gave 13.7 percent of plants injured as compared with 24.2 percent for the first year.

Corn earworm studies. In cooperation with the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture, hibernation studies on the corn earworm were started in 1935 and continued to the present. Each year, in September, eight cages are sunk in the ground stocked with full-fed corn earworm larvae. Within a few days, they enter the ground to pass the winter. Two cages are examined in November, two in April, and the remainder are left undisturbed to yield moths late in the spring.

Last fall, each cage was stocked with 100 worms. Examination on November 3, 1937, showed a large number of live pupae but no live larvae. Most of the pupae were found at depths between 2 and 3½ inches. There was no indication of any adults having emerged. Two cages will be examined for living larvae and pupae in April and the remaining ones observed for moths during May, June, and July.

Japanese beetle. The second season of trapping for Japanese beetle has been completed. Three beetles were taken in 1936, two in Louisville and one in Lexington. This work was done by the Bureau of Entomology and Plant Quarantine. Traps were placed in Louisville, Lexington, Frankfort, and Newport, in 1937. Eleven beetles were caught this season: six males and four females in Louisville, and one male in Lexington. Traps were also placed in Henderson, Covington, and Ashland, in 1936, but with negative results.

Oriental fruit moth parasite project. In 1936, a cooperative project on Oriental fruit moth parasites was set up by the U. S. Bureau of Entomology and Plant Quarantine and the Department of Entomology of the Kentucky Agricultural Experiment Station. The purpose of this project is to attempt to control the Oriental fruit moth by the introduction into Kentucky orchards of various promising foreign and native parasites. During 1936, 23 releases of 4,387 parasites in 19 commercial, Kentucky peach orchards were made. The 4,387 parasites belonged to six different species, of which *Dioctes molestae* was in the majority.

In 1937, to check on the present status of Oriental fruit moth parasites in Kentucky and determine the need for future liberations, collections of infested twigs were made by the Kentucky Department of Entomology and Botany. The first series of collections was made at about the time the larvae of the first brood were most abundant; the second when larvae of the second brood were abundant. Twigs so collected were sent to the U. S. Oriental Fruit Moth Parasite Investigations at Moorestown, New Jersey, where the parasite and moth emergence was calculated.

It was possible to make first-brood collections of wilted twigs from 13 of the 19 peach orchards where liberations had been made. Nine collections were made of second-brood material. Infestation by the Oriental fruit moth was rather low in many of these orchards making collection of material in the proper, freshly-wilted stage difficult. In orchards where no collections are reported, Oriental moth was too scarce for collections to be made.

In 1937, liberations of additional parasites were made by the

Department of Entomology and Botany with material reared and shipped by the Oriental Fruit Moth Parasites Investigation laboratory. In all, 1,148 parasites belonging to the single species *Dioctes molestae* were released. Releases were made in three commercial peach orchards in the vicinity of Paducah, on July 3, 1937.

May-beetle survey. May beetles, the adults of white grubs, caused little injury to foliage in the spring of 1937. May beetle grubs did considerable damage to strawberries in western Kentucky. During the flight season, beetles belonging to 21 species were collected from various localities in the state. Nine of these species, *Phyllophaga arkansana, hirtiventris, implicita, micans, praetermissa, profunda, prunina, quercus,* and *vehemens,* were not known from the state previously. As a result of May beetle collections the past two years, the total number of species known to occur in Kentucky has been increased to 26. Most of the May beetle species common in the Bluegrass region were scarce or absent in western Kentucky. Many of the species found commonly in western Kentucky are not known to occur in the Bluegrass. Because of this variation in species distribution, control recommendations in the Bluegrass will have to be revised for other localities.

May beetle flight began April 22 at Princeton, and continued into August. The flight period was prolonged because some species such as *P. praetermissa, tristis, bipartita,* and *fervida,* flew during the first of the season, while still other species did not appear until considerably later. *P. ephilida,* in particular, did not begin flying until the first part of July. Common species of May beetles found in western Kentucky were *P. ephilida, implicita, bipartita, hirticula, crenulata, arkansana,* and *micans.*

Identification of white grubs. In the past, studies of white grub damage and habits have been handicapped by the lack of keys for the determination of the species involved. The grubs of 17 of the 26 known Kentucky species were studied by the use of grubs reared from eggs laid by identified adult May beetles and by the use of cast skins. A field key was made for the separation of 14 of these species.

Phony peach disease. The Central Plant Board has recommended that all nurseries growing peach stock in states where

phony peach disease has been found be given the environs inspection. This means that every peach tree within a radius of one mile of the peach stock in the nursery shall be examined for this trouble. Kentucky has complied with this recommendation the past two years. Also the principal commercial peach orchards in the state were inspected. This makes three years that several of these orchards have been inspected for phony peach disease. Nine trees were found to be infected with the disease and all of them have been removed and destroyed as recommended.

Oil-nicotine spray. Tests with nicotine in oil atomized spray, developed in 1936, were continued. The material continued to give a high percent kill of various insects when used in the laboratory or greenhouse. In small-scale, field tests, probably due to the lack of suitable equipment, poor results (0-65% kill) were obtained with resistant species of insects, such as adult blister beetles, striped cucumber beetles, harlequin cabbage bugs, various cabbage worms, potato beetle larvae, Mexican bean beetle larvae, adult leafhoppers and squash bug nymphs.

Orchard insects. The life history of the codling moth in western Kentucky was studied by rearing larvae and the maintenance of bait traps. In the Paducah orchard region, spring-brood codling moths began flying May 5 and continued to do so until May 30. First-generation moths in the same locality began emerging June 13 and the flight was prolonged until the end of July. Observations were also made on the seasonal activity of Oriental fruit moth, plum curculio, apple leafhoppers, and rosy apple aphis.

Biology and control of the strawberry crown borer. An intensive study of the crown borer, serious pest of strawberries in western Kentucky, was begun in February. By detailed rearing work, it was found that no crown borer eggs were laid until early in March. This means that plants for new patches should be dug before March 1 in western Kentucky. By the same methods, the crown borer was found to have two generations in 1937.

The crown borer was found breeding in the wild strawberry and in common cinquefoil, *Potentilla canadensis*, and infestation

in many strawberry patches was traced to nearby cinquefoil. This suggests that the crown borer is a native Kentucky insect.

One parasite, *Microbracon analcidis* Ashm., and two predators, *Hister americanus* Payk. and *Menocrepidius auritus* Herbst were found attacking the crown borer. The larvae of *M. analcidis* parasitized about two percent of the crown borer larvae examined.

Marking experiments with 1,038 adult crown borer showed that, altho the beetles cannot fly, they can travel considerable distances by crawling. One beetle traveled 300 yards to a strawberry patch, without a source of food between its point of release and the patch. It was concluded that a new patch must be set at least 350 yards from a source of infestation if it is to remain free of crown borer.

It was possible to free infested plants of crown borer by digging prior to March 1 before the first eggs were laid and carefully cleaning and washing to remove any adhering adult beetles. Under field conditions, the use of certified plants was a safer procedure. Plowing infested patches, use of certified plants, destruction of native host plants, and setting new patches at a safe distance from infestation appeared to be important control measures.

Seed inspection. The number of samples received for examination was 4,876. Purity tests were made upon 2,689, and 4,395 samples were germinated. The distribution of samples tested was as follows: Grasses, 655; clovers, 1,468; vegetables, 24; large seed, 686; collectors' samples 570; tobacco, 1,473. Tobacco seed cleaned, 2,478 pounds, compared with 1,112 pounds in 1936, and 434 pounds in 1935.

Nursery Inspection. Inspection required 19,982 miles of travel in making 207 inspections as follows:

51 of general nursery stock
6 of fruit stock only
12 of perennials, bulbs, etc.
82 of strawberry plants
50 of sweetpotato plant beds
5 of sweetpotatoes in storage
1 of tomato plants.

These inspections covered 1,024 acres, distributed as follows:

871 of general nursery stock
12¼ of fruit stock only
13½ of perennials, bulbs, etc.
113¼ of strawberry plants
15 of tomato plants.
62,116 square feet of sweetpotato plant beds, and
1,025 bushels of seed sweetpotatoes in storage.

Certificates were refused on 59 fields of strawberry plants because of crown borer, and three sweetpotato plant beds because of black rot and stem rot.

In the order of their frequency of occurrence, the following insects and plant diseases were found during the period of inspections: strawberry crown borer, bagworm, dahlia leafhopper, strawberry rootworm, white grub, apple leafhopper, San Jose scale, elm leaf beetle, peach tree borer, blister beetle, cucumber beetle, tarnished plant bug, grasshopper, poplar leaf tier, catalpa sphinx, and coxcomb elm gall; (diseases) cedar rust, black spot (roses), peony blotch, damping off, iris rot, cherry leaf spot, crown gall (apple), lombardy canker, apple scab, pussy willow canker, juniper twig blight, dahlia stunt, and phlox rust. In each case, specific written instructions embodying the most up-to-date available control measures were given. In case of pests which needed attention as a condition for certification, recommendations were given and a check made later to ascertan compliance.

Creamery license. Inspections numbered 1245 and required 24,915 individual tests, or an average of twenty per inspection. The operators were graded as follows, A, B, and C, 952: D (probation) 244; E (to be called before the Examining Board) 49. The proportion of inspections graded D and E continues high. Graduated glassware tested for accuracy numbered 29,252 pieces of which 23 were rejected; also 97 nine-gram weights, 8 test scales, 3 centrifuges, 2 platform scales and 2 dividers were condemned and 45 illegal test bottles were confiscated.

The Examining board considered the cases of 47 operators because of inaccurate testing and failure to comply with regu-

lations. The licenses of 28 were revoked, 16 were placed on strict probation with provision for revocation of license if future inspections were not satisfactory, and 3 requests for reinstatement were denied. The cases of two operators are pending.

Licenses to buy milk and cream on the butterfat basis were issued to 10 creameries, 15 cheese factories, 7 condenseries, 57 milk plants, 42 independent operators of cream stations and 1290 cream stations operated by creameries. These total 1421, of which 1339 were renewals and 82 new buying places in operation since June 30, 1937. Permits in lieu of license to test, pending examination and now in force, were issued to 94 operators of the Babcock test; new licenses were issued to 221 applicants and renewal licenses to 1163 operators; all of which expire June 30, 1938. Examinations for license to test held at different places in the state numbered 42; 380 persons took the examinations, of whom 44 failed to make a passing grade.

The receipts for the year were $12,806.67 and the expenditures $13,692.34, as itemized:

Salaries	$9,360.00
Labor	1,451.14
Postage and stationery	483.56
Freight and express	44.60
Sundry and laboratory supplies	89.82
Travel	2,263.22
	$13,692.34

Feed control. In addition to the regular activities, special attention was given to mineral feeds containing fluorine and to standards for canned dog feeds. It was found that some manufacturers of mineral mixtures for livestock were adding 10 to 20 percent of rock phosphate, a carrier of fluorine. Analyses of mineral mixtures containing 20 percent of rock phosphate showed that they contained as much as 0.55 percent of fluorine. Before the danger of excessive fluorine in the feed of livestock was generally recognized, ground rock phosphate was commonly used in mineral feeds as a cheap source of phosphorus and calcium. In recent years, however, it has been shown conclusively that a relatively small proportion of rock phosphate in the diet of an animal may act as a poison, because of the fluorine content. Because even a very small

amount of fluorine in the feed may be injurious to livestock, registrations of all brands of mineral feeds containing rock phosphate were cancelled and registration was permitted only after elimination of rock phosphate from the list of ingredients.

Study of the dog feed business was continued. Its growth has been so sudden and the proportions so enormous, especially in canned feeds, that the manufacturers have lost control of it. They are divided on the ethics of the business. Few states, if any, have adequate laws for its control. Those that have laws are hesitant in attempting to regulate its conduct.

In some brands of canned dog feed the total nutrients in a pound can were worth less than a cent, which leaves a difference of five cents or more as the cost of the water content. In view of the extensive fraud practiced by many manufacturers of canned dog feed, the department has established minimum chemical standards for such feeds. These standards have been the subject of study for the past two years and are approved by most reputable manufacturers of this class of feed. These standards are:

Minimum protein	10.0 percent
Minimum fat	2.0 percent
Maximum fiber	1.5 percent
Maximum water	74.0 percent

For the year, 1,344 samples of feed were analyzed chemically and microscopically. Of this number, 934 were official samples for check analysis against guaranties of manufacturers. The remaining 410 samples were analyzed for feeders and dealers, and in the investigational work of the Department, or for other departments of the Station. Six violations of the law have been reported for prosecution. These suits are pending trial.

Fertilizer Control. Registration of fertilizers showed 716 different brands offered for sale in the state. Samples for analysis collected by inspectors and sent in by farmers numbered 796. A total of 3,086,000 tags were issued to the various firms carrying on business in the state.

Public Service Laboratories. The following synopsis shows

the large volume of work handled by the laboratories during the year.

Bacteriological Laboratory. Samples for bacteriological, microscopical and serological examination	176,278
Food Laboratory. Various food samples analyzed	1,091
Drug Laboratory. Samples analyzed and examinations for poisons	240
Total	177,609
Sterilized containers prepared and sent out	106,044

In the Bacteriological Laboratory the number of samples examined each month ranged from 8,864 in February to 17,544 in July. They may be classified roughly as follows:

Serological examinations	133,820
Agglutination tests	7,216
Microscopical examinations	11,458
Cultures	12,734
Bacteriological examinations of water, milk, cream and ice cream	9,570
Various food products	180
Miscellaneous	1,301
Total	176,279

Of the microscopical examinations, 317 were of the brains of animals for rabies. Of these, 166 were positive.

The bacteriological laboratory gave service to 82 county health departments, 11 state institutions, 12 city clinics and hospitals, 57 private hospitals and clinics, 1,284 individual physicians and a large number of individuals.

Preparation of sterile containers in which specimens for examination are to be forwarded to the laboratory, are an important part of the service which requires much labor and time. The use of proper containers is necessary, both to assure reliable results and to guard against possible infection of workers in the laboratory.

Samples analyzed in the Food Laboratory may be classified as follows:

Milk and dairy products	1,014
Hamburger and other meat products	49
Various foods and non-alcoholic beverages	28
Total	1,091

Of the 240 samples analyzed by the Drug Laboratory, 100

were for poison, including one human and 49 cases of animal poisoning.

The Bureau of Foods, Drugs and Hotels submitted 20 samples. Of these, 12 were solutions and powders intended for cleaning dishes and glasses at restaurants and soda fountains. Few of the products examined had sufficient germicidal value to render them effective.

ROBINSON SUBSTATION

Farming. Season being favorable, all crops produced well, the yields of both corn and hay being much better than in 1936. The corn crop was the best in any year since the Substation was established. Tennessee Red Cob and Reid's Yellow Dent raised on land where rotation was practiced for some ten years produced sixty-five bushels to the acre, whereas on land on which no rotation was practiced and no fertilizer used, the yield was only thirty-five bushels. Red clover was grown as a hay crop this year for the first time.

The fruit crop as a whole was good and quite a quantity was marketed locally. Fruits that made good yields were apples, peaches, cherries, grapes, and strawberries. Apples sold at $1.00 per bushel; peaches, $1.50 per bushel; grapes, $1.50 per bushel, cherries and strawberries, 40 cents per gallon.

Assistance rendered farmers. Three Jersey males are farmed out for service, two in Breathitt county and one in Perry county. Service to the Duroc Jersey and Hampshire males was free to farmers thruout the year. Some 200 bushels of tested corn was exchanged with farmers, bushel for bushel. The farmer brings in a bushel of feed corn and in return is given a bushel of seed corn. Purebred cockerels were exchanged for scrub cockerels. These exchanges are made to help improve the farm flocks. Seeds for pasture mixtures were ordered, mixed and sown for them and advice given along lines pertaining to farming and livestock raising.

Work on the Robinson forest. A six-weeks' camp was held at Camp Robinson early in June under the direction of the

College of Engineering, with several civil engineering students and one mining engineering student attending. The engineers assisted in locating roads and laid the foundation for base maps to aid in a re-survey of strips used in original timber estimates. They also made extensive explorations in search of coal seams in the forest region. The main activity of the forester during the spring and fall was attempting, with the assistance of fire wardens, to control forest fires. There were some 46 fires in the spring and 4 in the fall, many of which did considerable damage.

Response of sorghum to fertilizers. At the Quicksand substation unfertilized plots produced 68 pails of sirup per acre; 400 lbs. of 16 percent superphosphate fertilizer did not improve production; 400 lbs. superphosphate of 16 percent and 200 lbs. of nitrate of soda, produced 126 pails; adding 50 lbs. of muriate of potash increased this yield to 151 pails. Adding one ton of limestone to a like fertilized plot reduced the yield to 122 pails. Six tons of manure plus 400 lbs. of 16 percent superphosphate as the sole treatment resulted in a production of 80 pails. It appears that nitrogen is the most effective element in increasing yield of sirup on this particular soil. It is perhaps significant that the juice from the plots treated with nitrogen contained from 2 to 3½ percent more sugar than that from other plots.

Meetings. The following meetings were held: A leaders' conference; a camp for farm women; and a 4-H camp for boys and girls. The Twelfth Annual Robinson Harvest Festival attracted many visitors not only from the immediate vicinity but also from more remote sections of the eastern part of the state. The entries of agricultural products and home industries were of excellent quality. The Fifth Regional Conference for Southern Mountain Workers was held at the Substation and was well attended.

WESTERN KENTUCKY SUBSTATION

Lespedeza gives large response to good soil treatment. Lespedeza does fairly well on most Kentucky soils and gives excellent response to good soil treatment. Comparative yields of hay

and of corn and wheat which followed lespedeza in the rotation were as follows:

Soil Treatment	Lespedeza hay, Lbs. Ave. 10 crops	Corn, Bus. Ave. 9 crops	Wheat, Bus. Ave. 9 crops
Untreated plot	964	30.6	6.6
Superphosphate	1940	38.3	11.8
Limestone and superphosphate	3318	50.1	15.7

Rotation experiments with dark tobacco. It is generally recognized that the crop rotation in which dark tobacco is grown has considerable influence on both yield and quality of the tobacco.

	Yield and acre value of tobacco Average last 8 crops	
Four-year rotation	Pounds	Dollars
Wheat-alfalfa-alfalfa-tobacco	1113	105
Wheat-clover-orchard grass-tobacco	1126	109
Corn-wheat-clover-tobacco	1026	86
Wheat-clover-corn-tobacco	965	76
Eight-year rotation		
Wheat-clover-bluegrass 4 years-tobacco-tobacco	1138	113
Six-year rotation of fertilizer tests		
Wheat-clover and grass 3 years-tobacco-tobacco	1105	107

Where to use fertilizers in the cropping system. Results from 1929 to 1936 at Princeton, on the sandstone soil, indicate that mineral fertilizers—phosphate and potash—are more effective when used directly ahead of the small grain than when used under the corn in a rotation of corn, wheat, and mixed clover hay. Fertilizers used on the wheat land directly benefit not only the wheat, but also the legumes which are seeded thereon. Readily available nitrogen fertilizer, if used, should be applied as spring top dressing on the wheat and in the hill or row for corn.

Unfertilized land in this rotation yielded an average of

21.3 bushels of corn per acre
3.6 bushels of wheat per acre
1276 pounds of hay per acre

The average of four treatments consisting of P, PK, PN and PKN shows increased yields over the unfertilized land as follows:

	Corn	Wheat	Clover
Fertilizers used under corn	18.3	9.9	2067
Fertilizers used under wheat	17.6	13.2	2469

Princeton (sandstone soil). Average of 1935, 1936, 1937 corn crops. Bus. per acre

Fertilizers applied	P	PK	NP	NPK
Broadcast	35.4	34.2	37.1	34.8
Part broadcast) Part in hill)	34.5	34.7	35.7	37.5
Campbellsville. Average of 1934, 1935 and 1936 corn crops. Bus. per acre.				
Broadcast	63.1	65.5	65.2	67.1
Part broadcast) Part in hill)	61.5	64.6	65.2	66.8

Effect of limestone and superphosphate fertilizer on corn. An item of very general farm interest is found in the fact that a corn yield of approximately 40 bushels per acre was made on a 20-acre field on land that would have made only 5 to 10 bushels per acre before it was treated with limestone and superphosphate in 1927 and seeded to a mixture of clovers and grasses in 1928. Since that time this field has been used as a general pasture, until plowed last winter for corn in 1937. The increase in the productiveness of this field is typical of the results obtained on numerous general fields of the substation farm where there are excellent soils of Kentucky bluegrass.

Curing dark fired tobacco. This experiment compares the so-called "soft" with the "modified old method" of curing, using low temperature and high humidity in the former as compared with high temperature and low humidity in the latter. The results of last year's and this year's tests show clearly that first-class tobacco, which sold at or near the top of the market, was produced by both methods. The first year the tobacco cured by the "old method" sold slightly higher and was rated one grade higher by Government graders than that which was cured by the "soft method." This year there was practically no difference in the quality or grades of tobacco produced by each method.

Orchard drainage project. During June, 1937, an orchard drainage project was established to determine the advisability of draining a soil underlaid with a compact silty loam, for the growing of peach trees and to also determine the most effec tive depth to place the tile.

A total of 1988 bushels of peaches, clean, smooth and prac-

tically free from worms and brown rot were harvested from the 356 trees on the plots this year. The average yield per tree for the entire area was 5.58 bushels.

Altho the yields on the drained area were higher than on the undrained plots, as this is the first year that a good crop has been produced, no definite conclusions can be drawn regarding the benefits of tile drainage.

Treated and untreated pasture. Three fields of ten acres each on the Princeton substation farm are used for pasture experiments. One field has received no lime, phosphate or any fertilizer. Another field has received to date 2½ tons of limestone and the equivalent of 1000 pounds of 16 percent superphosphate. The third field has received to date 2000 pounds of rock phosphate per acre.

During the grazing season of 1937 the untreated plot produced 41 pounds of gain per acre in steer weight in 139 days of grazing. The second plot produced 181.7 pounds per acre, while the third plot produced 213.8 pounds in the 146 days. On the rock phosphate treated field there was a very heavy stand and excellent growth of hop clover (Trifolium procumbens) during early summer. The grasses also were this year more vigorous on this plot than they have been previously.

Comparison of Phosphates. In continuation of the experiment to compare the effectiveness of different phosphates, the following results were obtained:

	Corn Bus Average 7 crops	Wheat Bus. Average 7 crops	Hay Lbs. Average 7 crops
Average acre yields for five untreated check plots	16.9	3.0	1250
Increase for treatments over check plots.			
Superphosphate, potash and nitrogen	13.9	9.6	1050
Fine rock phosphate, potash and nitrogen	15.5	11.4	1652
Basic slag, potash and nitrogen	14.9	8.0	1672
Limestone, superphosphate, potash, nitrogen	16.2	10.1	1971
Limestone, fine rock phosphate, potash, nitrogen	14.9	8.4	2347
Limestone, ordinary rock phosphate, potash, nitrogen	13.3	7.4	1836
Limestone, superphosphate, potash, nitrogen	14.1	9.1	1482
Limestone, fine rock phosphate, potash, nitrogen	12.9	6.9	1324

Peach orchard culture experiment. The purpose of the planting was to test the importance of certain cultivation, cover crop and fertilizer practices using 12 trees to the plot. Altho part of the difference in yield undoubtedly was due to differ-

ences in soil, certain relationships were indicated. Cultivation may stimulate growth and yield, whereas legume sod may have the opposite effect. The seven plots which were sown to lespedeza or sweet clover when the trees were young produced stunted trees and small crops and the size of fruit this year was below the average of other plots. It is not clear whether this was due to a lack of absorption of rainfall, to the use of insufficient amounts of nitrogen fertilizer or to some other cause. In 1933 plots 8 and 9 which had received cultivation and cover crop treatment for 5 years and which appeared to be among the best plots were sown to lespedeza and one thoro cultivation was given early each spring. During the past five years these trees appear to have maintained their vigor and the crop this year was equal to the best. Because of the spring cultivation the soil in these plots probably absorbed more rainfall than the other sod plots. Thus it appears, on the one hand, that some cultivation each year may be beneficial and that the land probably should not be seeded down to sod crops while the trees are small. On the other hand, it appears that legume sods may be used in bearing orchards to advantage thru reduced labor cost and reduced depletion of the soil. Legume sods that received no nitrogen fertilizer resulted in very poor growth and yield. The use of a mulch of straw or manure around trees in sod seemed to be beneficial. There was no evidence that either potassium or phosphorus fertilization had any effect on the trees or fruit.

Comparisons were made in another orchard on practices in cultivation and cover crops in part similar to those made in the afore-mentioned orchard, but on a quite different type of soil. There are 36 trees in each plot and all received uniform fertilization. Plots 8 and 10 which have been kept in sweet clover and lespedeza, respectively, from the beginning, show marked stunting of the trees. Plot 5 which had been cultivated and on which soybeans had been grown in summer and rye in winter, during the first four years, was seeded to Korean lespedeza each year after thoro cultivation in the spring to June 1st. This plot appeared to be one of the best during the life of the orchard. This points again to the satisfactory use of legume sods on mature trees where annual cultivation was

practiced and to the stunting effect on young trees that are left uncultivated.

Apple experiment. The plot that was cultivated and sown to rye and vetch each fall has continued to make better growth than the plots in sweet clover and lespedeza. The crop in the cultivated plot averaged 4.6 bushels per tree, in the sweet clover plot 3.3 bushels and in the lespedeza plot 3.1 bushels per tree. All trees have received uniform fertilization. The trees in the legume sod plots are noticeably stunted. These results seem to indicate that the general effect of cultural treatment on young apple trees is the same as on peaches.

Farm production. The farm generally has had a satisfactory year. The season was favorable for practically all crops, tho very dry in late August and September, resulting in marked damage to pastures. The 1936 tobacco crop (marketed in 1937) sold near the top of a good tobacco market; a 4000 bushel peach crop was harvested from the orchard plots and sold at fairly satisfactory prices; a fine apple crop was harvested, but market was very poor and income from this crop was rather low; hay crops were good; and corn and tobacco crops were excellent in yield and quality. An unusually fine crop of wheat was harvested. The dairy herd will complete the year with an average of approximately 7800 lbs. of milk, and 385 lbs. butterfat per cow. The poultry flocks made a good production record and returns from both dairy and poultry sales were very satisfactory.

Meetings. Meetings were held as follows: Sixth annual short course; District Home Agents' Electric School; Caldwell County 4-H Clubs' Annual Meeting and Picnic; Rural rehabilitaion meeting; special poultry meeting; the 4-H Club Leaders' Conference; annual field day meeting; several special county meetings for inspection of projects; two 4-H club camps; frequent visits by agricultural high-school classes; rural church council conference. The attendance at meetings held in 1937 was larger than in former years.

NEW PROJECTS

The effect of phosphate fertilization upon the chemical qualities of soils and crops.

Intensive production of farm crops in the mountains.

The effect of superphosphate, alone and in combination with limestone, on herbage production of three pasture mixtures in Calloway County, Kentucky.

A study of the causes of the occurrence of medullated wool fiber and black fibers and related characters in the fleece of sheep.

Breeding turkeys that meet consumer demand and possess standard qualities to a high degree.

Periodic ophthalmia of horses and mules.

Life history and habits of the strawberry crown borer (Tyloderma fragariae).

Hypocalcemia and hypomagnesemia in domestic animals.

Analysis of marketing problems, operating practices and membership attitudes of Falls Cities Cooperative Milk Producers' Association.

Distillers' dried grains vs. cottonseed meal for fattening steers.

Distillers' corn dried grains vs cottonseed meal for beef cows.

Distillers' corn dried grains vs. cottonseed meal in the growing and fattening of feeder yearling heifers.

Avian coccidiosis.

Fruit-growing demonstrations.

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No. 368. Organization of Louisville wholesale fruit and vegetable market. H. B. Price, C. D. Phillips and S. E. Wrather. March, 1937.

No. 369. The presence of agglutinins for Brucella abortus in milk. H. B. Morrison and F. E. Hull. April, 1937.

No. 370. Oil-nicotine, a promising new insecticide. P. O. Ritcher and R. K. Calfee. July, 1937.

No. 371. Chondrodystrophy in the chick embryo. Malcolm Lyons and W. M. Insko, Jr., July, 1937.

No. 372. The incidence of streptococcic infection in the udders of Bang's disease positive and negative cows. H. B. Morrison and F. E. Hull. July, 1937.

No. 373. Albuminuria and nephritis in dairy cows. H. J. Metzger, F. E. Hull and Fordyce Ely. July, 1937.

No. 374. Legumes in cropping systems. George Roberts. August, 1937.

No. 375. Family incomes and land utilization in Knox County. W. D. Nicholls, John H. Bondurant and Z. L. Galloway. November, 1937.

No. 376. Tobacco mosaic. Sources of infection and control. W. D. Valleau and E. M. Johnson. December, 1937.

No. 377. Milk marketing in Lexington. John B. Roberts and H. B. Price. December, 1937.

Station Circulars:

No. 46. Distillery slop in chick rations. W. M. Insko, Jr., G. Davis Buckner, J. Holmes Martin and Amanda Harms. January, 1937.

No. 47. Control of insects commonly affecting tobacco plant beds. H. H. Jewett. February, 1937.

No. 48. The value of leaf meals of alfalfa, Korean lespedeza and lespedeza sericea in all-mash chick rations. G. D. Buckner, W. M. Insko, Jr., J. Holmes Martin and Amanda Harms. June, 1937.

Annual Reports:

49th Annual Report of the Station. Part I. Report of the Director for 1936. Thomas Cooper.

49th Annual Report of the Station. Part II. Thomas Cooper.

List of publications of the Experiment Station, 1885-1937, and of the Extension Division, 1911-1937.

Regulatory Series Bulletins:

No. 11. Seed inspection in Kentucky, 1934-1936. W. A. Price, E. C. Vaughn, Encil Deen, Jessie Taylor and Alice Marrs. January, 1937.

No. 12. Inspection, certification, and transportation of nursery stock in Kentucky, with a brief report for the year ended June 30, 1936. W. A. Price and Howard G. Tilson. January, 1937.

No. 13. Seed inspection in Kentucky, 1936-1937. W. A. Price, E. C. Vaughn, Encil Deen, Howard G. Tilson, Jessie Taylor, Alice Marrs, Katherine Fried and Margaret Morton. July, 1937.

No. 14. Commercial feeds in Kentucky in 1936. J. D. Turner, Howell D. Spears, W. G. Terrell and L. V. Amburgey. July, 1937.

Scientific Papers:

Review of Frederick A. Wolf's "Tobacco Diseases and Decays." Duke University Press. W. D. Valleau. Phytopathology 27 : 208-10. 1937.

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Pasture mixtures. E. N. Fergus. Presented at the Pasture Symposium of the Association of Southern Agricultural Workers, Nashville, Tenn., Feb. 4, 1937, and published in the Proceedings.

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The influence of distillery slop on the production of chicken fat. G. D. Buckner, W. M. Insko, Jr., J. Holmes Martin and Amanda Harms. Presented at the annual meeting of the Poultry Science Association, Madison, Wis., August 9, 1937.

Kentucky bluegrass in all-mash rations. G. D. Buckner, W. M. Insko, Jr., J. Holmes Martin and Amanda Harms. Poultry Science, 16 (6): 426-427, Nov. 1937.

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Studies on milk samples from Bang-positive and Bang-negative cows. H. B. Morrison, and F. E. Hull. Presented at meeting of the International Association of Milk Sanitarians, at Louisville, Oct. 11, 1937, by H. B. Morrison, and to be published in the Journal of Milk Technology.

Chondrodystrophy in the chick embryo produced by a mineral deficiency in the diet of the hen. Malcolm Lyons and W. M. Insko, Jr., Science, 86 (2232): 328, Oct. 8, 1937.

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Periodic ophthalmia. W. W. Dimock. Presented at the annual meeting of the Ky. Vet. Med. Assn., July, 1937.

Periodic ophthalmia. W. W. Dimock. Presented at the annual meeting of the Horse and Mule Assn. of America, Chicago, Ill., Dec. 1, 1937, and to be published in the Proceedings.

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Report on less common elements in soil. J. S. McHargue. Associate Referee and W.T. Forsee. Jour. A. O. A. C. 20: 222-225, May, 1937.

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Control of the tobacco flea beetle (**Espitrix parvula**) in plant beds. H. H. Jewett, Jour. Econ. Ent., 30: 790-3, No. 5, October, 1937.

Experience in resettlement. W. D. Nicholls. Jour. of Farm Economics, 19: 220-223, 1937.

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A rapid method for determining soil moisture. E. M. Emmert. Soil Science, 43: 31-36, No. 1, January, 1937.

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FINANCIAL STATEMENT

In Account with the United States Appropriations, 1937.

Receipts	Hatch Fund	Adams Fund	Purnell Fund	Bankhead Jones	Bankhead-Jones Offset
From the Treasury of the United States, as per appropriations for fiscal year ended June 30, 1937	$15,000.00	$15,000.00	$60,000.00	$39,469.02	
Receipts from sources within the State as Bankhead-Jones offset					$40,879.09
Expenditures:					
Personal services	14,218.18	14,847.31	54,905.06	27,955.99	32,517.36
Supplies and materials	111.09	107.96	1,326.52	811.77	6,092.64
Communication service			98.72		
Travel expenses	247.58		1,593.33	647.63	154.30
Transportation of things			14.60	13.95	
Printing and illustrating publications	300.00		1,400.35		
Heat, light, water, and power		24.03	21.48		
Equipment	123.15	20.70	639.94	1,948.76	2,064.79
Buildings and land				8,090.92	50.00
Total	$15,000.00	$15,000.00	$60,000.00	$39,469.02	$40,879.09

We, the undersigned, duly appointed auditors of the expenditures, from Federal appropriations and Bankhead-Jones offset Funds reported herein, do hereby certify that we have examined the books and accounts of the Kentucky Agricultural Experiment Station for the fiscal year ended June 30, 1937; that we have found the same well kept and classified as above; and that the balances, receipts and disbursements are as follows:

	Hatch	Adams	Purnell	Bankhead-Jones	Total Federal Funds	Bankhead-Jones Offset
Receipts for the year from the Treasurer of the United States	$15,000.00	$15,000.00	$60,000.00	$39,469.02	$129,469.02	
Receipts from sources within the State						$40,879.09
Disbursements for the year	$15,000.00	$15,000.00	$60,000.00	$39,469.02	$129,469.02	$40,879.09
Unexpended balance, June 30, 1937	None	None	None	None	None	None

Proper vouchers for all of the above disbursements are on file and have been examined by us and found correct.

And we further certify that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887, March 16, 1906, and February 24, 1925, and June 29, 1935, and in accordance with the terms of said acts, respectively.

Signed: THOMAS COOPER,
Director of the Experiment Station.

D. H. PEAK,
Financial Officer of the Institution.

Attest:

JANE J. NICHOLS,
Custodian of the Seal.

D. H. PEAK,
Secretary of the Governing Board.